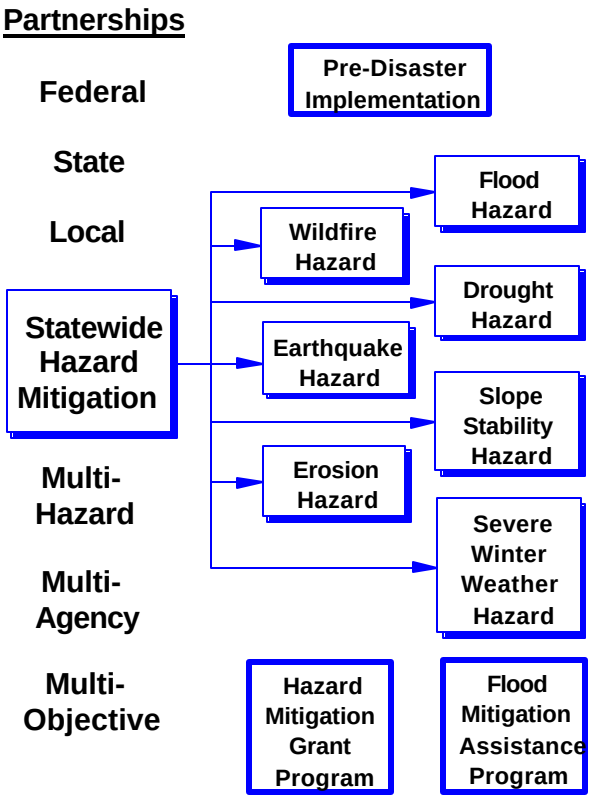
HAZARD MITIGATION PLAN

Utah 1999



COMPREHENSIVE EMERGENCY MANAGEMENT
a division of the

Since 1983, the State of Utah has experienced four Presidential Disaster Declarations and numerous emergencies. On April 30, 1983, following a massive landslide below the town of Thistle in Spanish Fork Canyon, President Ronald Reagan issued a Presidential Disaster Declareatioon for Utah. On May 5, 1983, a federal-state agreement for disaster assistance was executed. Under this agreement, designated FEMA-680-DR, Utah agreed to prepare a hazard mitigation plan, and to update it annually, for the areas included in the disaster declaration. By July 1, 1983, this was to include 22 counties.

Again, on August 17, 1984, President Reagan determined that damages resulting from severe storms, flooding, debris flows and landslides beginning on April 1, 1984, had caused a major disaster in the State of Utah. Under the Federal Disaster Relief Act of 1974, a FEMA/State Agreement, designated FEMA-720-DR, was issued and signed by then Governor Scott M. Matheson. This agreement called for the updating of the State Hazard Mitigation Plan.

A lesser disaster was declared for Utah by President Ronald Reagan on March 13, 1986, caused by severe flooding. Up until this point, 23 of Utah's 29 counties were involved in presidential disaster declarations and conducting hazard mitigation.

On January 31, 1989, President George Bush declared a Presidential Disaster for Washington County, Utah, due to the breach of a major dike at Quail Creek Reservoir that flooded along the Virgin River through the cities of Washington and St. George.

As a result of these four Presidential Disaster Declarations, Utah had prepared four State Hazard Mitigation Plans. As a result of these events in Utah, counties and communities conducted considerable hazard mitigation, especially for flood and debris flow, greatly reducing the risk in Utah. Since 1989, largely as a result of Utah's massive mitigation efforts of the 1980's, there have been no subsequent major disasters and the State Hazard Mitigation Plan has been updated through statewide and community hazard annexes, typically tied to more localized events.

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ACKNOWLEDGEMENTS

This plan was prepared through funding by the Federal Emergency Management Agency (FEMA) of the State Hazard Mitigation Program (SHMP), Project Impact, and through a grant obtained from the U.S. Bureau of Reclamation (BoR) for the preparation of a State Flood and Drought Mitigation Plan. The Utah Division of Comprehensive Emergency Management expresses its appreciation to those who assisted in providing this funding and making this plan possible. Those largely responsible are: FEMA (Sherryl Hahl, Steve Pratt, Floyd Shoemaker, and Tony Mendes) and BoR (Roger Hansen and Mike Stuver). The assistance of the Utah Interagency Technical Team, representing about ten Federal and 10 State agencies is an ongoing resource in preparing and implementing the Utah Hazard Mitigation Plan and in developing the knowledge base through many emergency response actions and ONSITE Reports, in conducting hazard and risk analyses, in assisting with development of local hazard mitigation plans, and in providing insight and review of the present document.

DIRECTORS MESSAGE

The Utah Hazard Mitigation Plan was introduced following the first Presidential Disaster Declaration in Utah in 1983. This Plan was required through an agreement between the Federal Emergency Management Agency (FEMA and the Governor of the State of Utah. This document was referred to as the FEMA/State Agreement and it required the preparation if a State Hazard Mitigation Plan. The subsequent Presidential Disaster Declaration of 1984, 1986, and 1989, likewise required the preparation, or update, of such a Plan. There have been no further Presidential Disaster Declarations since 1989 and no other requirements, except the updating of the State Hazard Mitigation Plan. Through a variety of grants over the intervening years, updates have been developed in the form of annexes or addendums consisting of local hazard mitigation plans, county vulnerability assessments, and Interagency Technical Team ONSITE Reports. NOTE: This present State Hazard Mitigation Plan addresses primarily hydrologic hazards. Seismic hazards are addressed to a large degree in A Strategic Plan for Earthquake Safety in Utah, produced by the Utah Seismic Safety Commission, where five prevention objectives are addressed, each consisting of several preparedness and mitigation measures and implementation strategies.

The State Hazard Mitigation Plan, and its annexes and addendums, is considered a living document, in that new insights, additions, or recommendations can be added at any time, especially following an emergency event when more is learned about Utah's hazards and vulnerabilities. Still, hazard mitigation is not easy to implement. There is no pre-disaster hazard mitigation fund at any level of Government within Utah. Still the exceptional amount of hazard mitigation conducted in the 1980's has reaped dividends. While other State in the nation incur disaster after disaster, Utah does not. Although an examination of the implementation of recommendations contained in the various Plans demonstrates that much has been done through the Plan, the great success stories comes from Utah's attitude for prevention. Although there is still much vulnerability to mitigate, it is difficult to pass through Utah's counties and cities without finding great examples of mitigation. What is the result of this statewide effort? If one looks at the ranking of the States nationwide, one finds that Utah is fourth from the bottom-of-the-list in numbers of Presidential's. Out of 50 States, Utah ranks 46th.

Utah lives in harmony with the physical expressions of its environment. It has been 12 years since Utah has had a Presidential Disaster Declaration caused by a natural hazard, and that disaster was considered by FEMA to be of minimal nature and extent. Annually, Utah experiences what is typical from its physical environment, and over the past 12 or 13 years we have monitored that through the ONSITE hazard analysis and mitigation efforts of the Utah Interagency Technical Team (IAT, a group of hazards professionals representing 10 State and Ten Federal agencies). What have they experienced? Appendix A1 documents these events for the past two years, but these events are quite typical of the past decade and more. No-one has been killed, and even rarely is anyone injured, from these events, except for wildfire, avalanche, and lightning, and these fatalities and injuries are still in very low numbers. For Utah, this does

not seem to cry out for a major focus on hazard mitigation. Still, the physical expressions of nature are present. The Utah IAT acts at the request of local governments to provide them with the needed technical expertise when there is a concern about natural hazards, or when there are emergencies. Events do happen.

The people of Utah do notice that localized natural hazards do cause "near-misses" on occasion. There are lucky people in Utah who narrowly-escape the devastating effects of the forces of natural hazards annually. Still, these are people here and there, but not large populations here and there. This has been the annual experience since the pioneers have lived in Utah's valleys. There have been harrowing floods, debris flows, severe weather, wildfires, and other, but Utah does not look back on any particular disaster that destroyed a city or town and a large number of its inhabitants.

In looking back at the floods and landslides of 1983 and 1984, one recognizes that nature can have a tremendous effect on Utah. Looking at this in balance though, those years were also years of bumper fruit crops and healthy cattle herds. It was not all bad. Still, there was "bad". This is the balance. In looking ahead, can we use the years of 1983 and 1984 as a measuring stick for the potential effects of natural hazards in the future. Cities and counties responded with a massive amount of mitigation. The 1983 and 1984 flood years cannot happen again in those same places because of mitigation and because of the pro-active attitude. Risk is greatly diminished.

Utah has natural hazards that do activate and cause concern, even potential for much loss. But nature has to be much more selective on where it strikes to cause those losses. Each year the Utah Interagency Team finds these places and addresses them with vulnerability assessments and mitigation. In coordinating hazard mitigation needs for local governments, the IAT has brought some $1.5 millions in mitigation funds to Utah in just the past few years. The word "coordination" is a word that describes Utah's success in reducing risk. We pull together. Resources are available in the several State and Federal agencies and the Utah IAT has learned to apply those resources through coordination. Each year, the Utah IAT makes Utah a little bit more safe.

What are the greatest fears of the Utah IAT? Likely debris flows and wildfires. These could suddenly cause a great loss of life and property. More mitigative work needs to be done in these areas. Those who work with these hazards realize how quickly disaster could strike. Still, each year the media make known that these threats exist. People are familiar with dangers of living in harms way. Disasters are in the news each week. People know that canyons produce debris flows, rivers produce floods, faults produce earthquakes, forests produce wildfires, etc. Ultimately, people take some responsibility for where they live. Government provides what people ask for. Each few months, people experience natural hazards in Utah and local emergency officials call upon the Utah IAT to provide a technical perception of what is happening and to increase planning and prevention in those areas.

Will Utah ever be striken by a major catastrophe? The responsibility of government is to protect people from the greatest expressions of nature that might occur during a 100-year period of time, not during a millenium. The representatives of government in Utah address hazards in established ways. Each time a city public works director puts in a culvert, or a State highway engineer puts in a bridge, or a structural engineer builds a building, there are considerations for mitigation. The question is can 100-year events be catastrophic in Utah? Should we mitigate for larger frequency events? The cost would be astronomical. It is also not possible to mitigate for all possibilities. For example, between Salt Lake City and Brigham City there are approximately 100 alluvial fans that could generate debris flows. Can these all be mitigated with

debris basins; most have some development downstream of them. Some should but the cost to mitigate them all would be astronomical. Still, mitigation is an ongoing effort.

Utah is participating in a new pre-disaster hazard mitigation program called Project Impact. Project Impact is provided through the Federal Emergency Management Agency (FEMA). One community is selected each year in each state to receive large grants to mitigate its hazards and become disaster resistant. Over the years, as more and more communities are selected for Project Impact, we will find each State nationwide becoming more disaster resistant. Eventually, the nation will become disaster resistant and disaster costs will drop greatly. Utah presently seems to be relatively disaster resistant for hydrologic hazards that occur within reasonable time-frames, but mitigation needs and opportunities still present themselves. As they do, the residents of the State of Utah, will continue in the ongoing effort of hazard mitigation.

Earl Morris, Director
Utah Division of Comprehensive Emergency Management

STATE HAZARD MITIGATION OFFICER

The State Hazard Analysis and Mitigation Plan is prepared by the State Hazard Mitigation Officer (SHMO) according to State Code (Chapter 52, Section 2, Subsection 104) as a result of interactions with several agencies of State and Federal Government and with local governments during: 1) times of emergency or concern about natural hazards, 2) during preparation of local hazard mitigation plans, and 3) during preparation of hazard and risk analyses. This planning process is coordinated by the State Hazard Mitigation Officer, Fred May, with the assistance of the Utah Interagency Technical Team (IAT). The information contained herein is derived from several years of experience with the Utah IAT, performing their functions statewide. The Utah IAT responds to requests for technical assistance for hazard and vulnerability analysis and mitigation planning during times of concern about natural hazards and times of emergency. During this process, ONSITE reports, local government mitigation plans, and county and city hazard analyses are prepared. The content of this Plan is derived largely from those documents. This Plan also contains retained hazard mitigation recommendations from prior State Hazard Mitigation Plans. Utah has not had a Presidential Disaster Declaration requiring the complete preparation of a State Hazard Mitigation Plan for almost a decade. The last major disaster caused by a natural hazard was in 1984 (1986 was a relatively minor disaster), and this was better than 14 years ago. During these intervening years, the State Hazard Mitigation Plan has been updated through local hazard mitigation planning, IAT ONSITE actions, and local hazard assessment, often associated with emergency events. The recommendations from these older plans have either been implemented or become obsolete, due to a general lack of apparent relevance (had those recommendations been viable, they would have been implemented).

It is the ongoing task of the Utah Interagency Technical Team to pursue implementation of hazard mitigation recommendations of the State Hazard Mitigation Plan, and the task of the State Hazard Mitigation officer to coordinate the resources of State government toward implementation. The frequent lack of pre-disaster hazard mitigation funding makes implementation a challenge, but opportunities arise.

Many recommendations do not require funding, but simply require creating awareness about hazards and mitigation. The spread of knowledge about hazard mitigation is quite impressive. In prior years, emergency management emphasized disaster preparedness, response, and recovery, but in the past few years hazard mitigation has become the emphasis. We are seeing more and more local officials using the "jargon" of pre-disaster hazard mitigation and looking to reduce local risk from natural hazards.

This Plan emphasizes hydrologic hazards, and this Plan will also grow as more recommendations are included due to increased knowledge. For example, the 1998 year was a period of time when landslides became a major issue, especially in northern Utah. These are addressed as far as they are understood for hazard mitigation in Utah. It is likely that the Utah Interagency Technical Team will add a more extended section addressing that hazard.

The highlight of 1998 has been the advent of Project Impact, a program sponsored by the Federal Emergency Management Agency (FEMA) where one community in each State is selected annually to receive mitigation funds and work toward becoming disaster resistant. Utah is now entering the second year of this program. In the first year, the city of Centerville was selected by FEMA, and that community is making large strides toward becoming disaster resistant. Centerville is assisted by a large array of Public Sector partners, largely coordinated by the State Hazard Mitigation Officer. Still, Project Impact is not a State effort and it is intended to be a "grass roots" effort. Centerville is carrying its "own weight" and directing its own program, having been well-prepared by the Utah Interagency Technical Team, coordinated by the State Hazard Mitigation Officer. With the emphasis shifting to pre-disaster mitigation funding, it is now likely that the barrier of lack of pre-disaster funding will begin to dissipate and more progress can be made. In beginning the second year, Salt Lake City was chosen for Project Impact.

Fred May, State Hazard Mitigation Officer
Utah Division of Comprehensive Emergency Management

EXECUTIVE SUMMARY

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Since the Presidential Disaster Declarations of 1983, 1984, 1986, and 1989, The State of Utah has met hazard mitigation planning requirements of the Federal Emergency Management Agency (FEMA) and the State through the development of several more localized hazard mitigation plans and related documents, based on state and local emergencies, or concern about known hazards. Hazard Mitigation is largely a local government activity, but planning and technical assistance for planning comes from the State Hazard Mitigation Planner and the IAT. The primary source of information and documentation for these later plans has been through the activities of the State Hazard Mitigation Team, which has come to be known as the Utah Interagency Technical Team (IAT). This IAT is activated when local governments express concern about natural hazards or experience actual emergencies. Following the Wasatch Mountain Wildfire of 1988, a State Wildfire Hazard Mitigation Plan was developed in 1992, which was later updated in 1994, coordinated with the Utah Division of Forestry, Fire, and State Lands and the member agencies of the IAT. Through grants provided by FEMA, hazard mitigation plans were prepared for Morgan County (flood), Summit County (wildfire), Wendover, Riverdale, Cedar City, and Centerville. To further update the states vulnerability assessment and mitigation planning, several county vulnerability assessments were conducted for Morgan County (flood), Rich County (flood, wildfire), Cache County (flood; earthquake; including separately Mendon - flood); Davis County (debris flow, wildfire, flood), Weber County (flood, earthquake); Box Elder County (flood, earthquake); Grand County (wildfire); Sanpete County (flood; separately including Spring City); San Juan County (drought, flood; including all its cities and towns); and Garfield County (drought and flood in preparation).

As a result of Utah IAT activations, considerable hazard mitigation grant funds have come to the counties and communities of Utah. It is no easy task to obtain grants for hazard mitigation projects, unless emergencies/disasters do occur. A recent statement by officials of Centerville, Davis County, and of FEMA support this awareness, in that when federal or state hazard mitigation grants appear, this will serve as the catalyst for local funding of hazard mitigation, as well. Federal grants are now appearing in the form of Project Impact Grants (discussed below) and Flood Mitigation Assistance Grants (also discussed below). Both of these granting sources are federal in origin. Still, the Utah IAT obtains mitigation grants for local governments. One method of obtaining grants is to represent the local government during/following a local flood emergency. To mitigate damaged river channels, the Utah IAT identifies projects that could be funded by the Natural Resources Conservation Service (NRCS), Emergency Watershed Protection Program. The NRCS cannot initiate such projects, but depends upon the Utah IAT to provide rapid technical assistance to local governments that lack engineering/geological/environmental expertise. In doing so, EWP projects are identified and coordinated with NRCS. This coordinated effort has resulted in hundreds of thousands of dollars coming to local governments for channel mitigation and protection of culinary water systems. The IAT also provides the technical assistance to obtain grants from the Utah Community Impact Board, the Community Development Block Grant Program (Emergency Fund), and the U.S. Bureau of Reclamation drought mitigation grant program. In all, it likely that the Utah IAT has coordinated well over $1 million in funds for local hazard mitigation in Utah.

Pre-disaster hazard mitigation requires much different resources than post-disaster, especially if the

disaster was declared by the President of the United States. During the pre-Presidential-disaster time frame, most kinds of grants are rare, but still the Utah IAT has succeeded. Recently, the Federal Government has created two main kinds of hazard mitigation grants: 1) Flood Mitigation Assistance Grants, which provides Utah with slightly more than $100,000 per year for projects in communities that participate in the National Flood Insurance Program (NFIP) and have a flood hazard mitigation plan in-place, and 2) Project Impact, which is a program intended to produce disaster-resistant communities nationwide. In the first round of Project Impact in Utah, Centerville, Davis County is anticipated to receive approximately $500,000 in FEMA grants for flood hazard mitigation, plus $90,000 in FMAP grant funds, and $5,000 in FMAP planning grant funds.

Utah, in spite of its excellent hazard mitigation history and subsequent general lack of major disaster events, is still vulnerable to natural hazards, and hazard mitigation planning and implementation should continue. Plans should still be prepared for local government implementation, to lessen the threat to the residents of the state.

New hazard mitigation issues facing the State include the conversion of agricultural land to urban and residential uses. We are discovering that new homes and businesses are being built in close proximity to aging irrigation canals that are generally elevated above the homes. In the past, when these irrigation canals would breach and flood, only farm land would be affected. Now homes are being affected. The first hazard mitigation plan for this kind of situation is being developed for the town of Mendon, Cache County. This plan is requiring new planning approaches and new ways of viewing flood threat in such areas.

INTRODUCTION

Quail Creek Dike breached on New Year's Eve, 1988.

While a combination of hydrologic, geologic, and wildfire hazards face Utah's diverse landscape and settlements, the specific hazards presented by flooding, landslides, high ground water, and debris flows became a harsh reality in 1983, 1984, and 1986. The 1989 breach of the dike at Quail Creek Reservoir was considered a technological hazard event, and was somewhat unique in Utah's history of disaster events. The State of Utah and more than 150 local government entities experienced severe disaster impact in 1983, 1984, 1986, and 1989. Those disasters cost the state in excess of $500 million. Through federal disaster assistance, the state also received approximately $60 million during those years. Since those times, emergencies have been declared in the following counties; Washington, Iron, Garfield, San Juan, Sanpete, Uintah, Duchesne, Summit, and Cache Counties.

This plan addresses primarily flood, wildfire, and drought hazard mitigation. Hazard mitigation planning is the process of analyzing a set of conditions relative to a natural hazard to determine if existing mitigation is adequate to reduce or eliminate impact should that hazard become active to a prescribed level, for example to the level of the 100-year flood.

All hazards have an associated set of impact-causing conditions, once a hazard becomes active. A Hazard Tree Analysis can be used as a planning tool to graphically depict a threat pathway, the potential sequences of events, and enable the community to obtain a visual statement as to the impact of the hazard. Hazard Tree Analyses have been used across the state as a basic tool in the Hazard Mitigation Assessment and Vulnerability Analysis within the Plan.

An important aspect of hazard mitigation planning is to obtain adequate input from skilled professionals who work with specific hazards and their associated impact-causing conditions. Through such input, the hazard mitigation planner can plan for those impact-causing conditions that are believed to present an unacceptable threat to life and to property. It is important to note that not all threat to life and property is termed unacceptable, because people must accept some risk for living where they do. In the planning process, the planner may identify other impact-causing conditions which may actually be considered acceptable, as a result of this input, and the use of Hazard Tree Analysis. The resulting Plan may not address the various identified acceptable impact-causing conditions, but only those believed to be unacceptable.

In today's world of mass media, it is ever more difficult for people to not have a general awareness of the kinds of impact that can befall them should they chose to live in particular physical settings. For example, it is common knowledge that flooding does occur along river bank areas. Such areas are also regulated by the federal government through the federal regulations of the National Flood Insurance Program. State governments also provide a function through the Community Assistance Program (CAP) by giving technical assistance to local government to help them remain compliant with the federal regulations. Flood-prone areas are mapped by the federal government and these maps are available to the communities participating in the National Flood Insurance Program. There are checks and balances designed to keep people informed as to where flood-prone areas are. Mortgages, including second mortgages, cannot be obtained unless a floodplain map determination is made for that structure. As a result, many people have a knowledge of the level of flood risk that they have assumed from riverine flooding. With such a level of awareness so readily available to the public, it is generally difficult to identify unacceptable threats to life and property within such mapped floodplains. Federally-mapped floodplains and their associated regulations are minimum standards and communities can improve on them by providing higher levels of public safety.

The objective of hazard mitigation planning is to describe mitigation measures that can reduce or eliminate impact from those unacceptable impact-causing conditions resulting from a hazard that may become active. The identification of what the community feels is an acceptable or unacceptable risk is essential to the Plan. From this concept of what can be and is being mitigated for, the planner then can assist the community in preparing for the potential threat of the hazard.

For example, within the realm of a hazard, it may be possible to **mitigate** for 40 percent of the potential impact associated with the threat through either structural or nonstructural measures. That being the case, theoretically, one might then be able to adequately **prepare** for the resulting 60 percent of potential impact.

AUTHORITY

The State of Utah conducts a hazard mitigation program designed to reduce, or in some cases eliminate, loss from disaster (see Utah Code Annotated, Title 53: 53-2-104. The State Hazard Mitigation Planner, within the Utah Department of Public Safety, coordinates the efforts of the State Hazard Mitigation Team (Utah Interagency Technical Team or IAT) to accomplish this responsibility, as directed by the Commissioner of Public Safety (see UCA 53-2-104(b) and documents establishing a State Hazard Mitigation Team by the Commissioner of Public Safety). The State, additionally, maintains a cooperative agreement with the Federal Emergency Management Agency (FEMA) through FEMA/State Agreements to maintain, update, and implement State Hazard Mitigation Plans as a condition of receiving Federal Disaster Assistance. Updating the State Plan involves addressing new major hazards as they become manifest through severe impact including loss of life and property (see FEMA/State Agreements for Presidential Disaster Declarations 680-DR, 720-DR, and 820-DR; also see Cooperative Agreements for (CCA-HMA) for 1984 through 1991). Generally, such planning is tied to local events. Because federal funding through FEMA and the U.S. Bureau of Reclamation (BoR) was provided for this project, authority for preparing this Plan also falls under Public Law 100-707, the "Robert T. Stafford Disaster Relief" and "Emergency Assistance Act", Section 409, and under Public Law 102-250, which requires updating of the State Hazard Mitigation Plan. This present Plan constitutes an update, or annex, to the Comprehensive State Hazard Mitigation plan. The recommendations within the Plan address flood, debris flow, wildfire, and drought hazards locally and statewide, as appropriate. The objective is to implement most recommendations, but the overall process is voluntary, except where implementation is required for a community rating through the National Flood Insurance Program's Community Rating System.

UTAH STATE CODE

In Utah Code 53-2-104, it is stated that the Utah Division of Comprehensive Emergency Management shall: (c) prepare, implement, and maintain programs and plans to provide for:

(i) prevention and minimization of injury and damage caused by disasters:

(iii) identification of areas particularly vulnerable to disasters;

(iv) coordination of hazard mitigation and other preventive and preparedness measures designed to eliminate or reduce disasters;

(v) assistance to local officials in designing local emergency action plans;

(vi) coordination of federal, state, and local emergency activities;

(vii) coordination of emergency operations plans with emergency plans of the federal government; and

(x) other measures necessary, incidental, or appropriate to this chapter.

In 53-2-104(i and iii), it is stated that designated employees of Utah CEM may engage, within the State of Utah, in prevention and minimization of injury and damage caused by disasters:, and in the identification of areas particularly vulnerable to disaster. These two items are not assigned as coordinating functions; whereas, items iv, vi, and vii are assigned as coordinating functions. Still for purposes of public safety, for those threatened by natural hazards, it is best to identify areas vulnerable to disaster through an interagency technical team, such as has been created by the State of Utah. This Team is called the Utah Interagency Technical Team (IAT), and is comprised of qualified technical representatives from several State and Federal agencies. Natural hazards, and their life-threatening behaviors, are understood and addressed best by qualified engineers, geologists, biologists, and environmental health specialists. Although the State Hazard Mitigation Officer may engage in items (i) and (iii), most often for purposes of public safety, a technical team is used in close coordination by local officials whose residents are being threatened by a natural hazard. For more Discussion see the section in this Plan on the Utah Interagency Technical Team.

PURPOSE:

In addition to fulfilling legal obligations under this aforementioned agreement and legislative mandates, this hazard mitigation plan serves the general purpose of planning for the safety of Utah's population and properties. It is clear that many activities of local governments and state government include hazard mitigation. For example, when the Utah Department of Transportation constructs a bridge or places a culvert, each is sized to pass a determined discharge or flow. Cities construct storm drain systems and place culverts; all include mitigation considerations. Beyond these efforts, there are more extreme needs for flood surges from mountain canyons and for wildfires that encroach into urban wildland interface communities. Still, the purpose of this plan is to keep mitigation recommendations reasonable and prudent. It is reasonable and prudent to mitigate up to the 100-year event, but likely too expensive to mitigate for events of greater frequency. This plan serves as a focal point and guide to federal, state, and local authorities involved in actions to reduce damages from floods, debris flows, and other natural hazards. It is also clear that federal agencies also conduct ongoing hazard mitigation. As an example, the U.S. Army Corps of Engineers conducts flood hazard studies for watersheds within Utah; these studies provide valuable information on flood frequencies and can result in costly mitigation measures. Mitigation measures detailed in this plan are directed at minimizing long-term and short-term impacts of these costly hazards, but only in situations beyond what is done by government agencies, or cities, on an ongoing basis. Given that Utah is 46th of 50 states in having the least number of Presidential Disaster Declarations, this plan should support the awareness that Utah is well mitigated, given its environment.

SCOPE:

Addressing issues relevant for Utah's counties, this plan will necessarily maintain a broad scope and perspective. From a county-by-county inventory. The focus is more detailed in counties where, to date, detailed vulnerability assessments have occurred. Given that it has been approximately one decade since the last major disaster in Utah, and 12 years since the last disaster caused by a natural hazard, it is not necessary to repeat many of the recommendations contained in the earlier plans. Much has been implemented, and some of the recommendation contained in the earlier plans that could not be fully implemented, have not maintained their stature as great needs. The needs have been diminished where masssive mitigation efforts occurred statewide, and other needs have not arisen. Thus, experience moves Utah into a new decade of mitigation considerations. The scope of this plan is based largely on the experiences of the Utah Interagency Technical Team (iAT) with natural hazards over the past decade, since the disasters of the 1980's and on the resulting vulnerability assessments conducted by the Utah IAT.

DISASTER RESISTANCE IN UTAH

Disaster resistance is a relatively new term in comprehensive emergency management. It originated primarily through Project Impact, but is a term used to describe a community's resistance to disaster. Resistance to disaster results through hazard mitigation, and must be viewed then as a measure of the effectiveness of hazard mitigation in a community. The effectiveness defines the reduction of population at risk from all major hazards. The ultimate objective would be to reduce all risk, but this is unlikely to happen. Realistically, a community's efforts can only partially, or moderately, or largely, reduce risk. Hazard mitigation can be expensive, or require a major community emphasis. It is best-approached through partnerships of government agencies, businesses, and citizens groups on an ongoing basis. Over time, a community becomes more and more disaster resistant.

Disaster resistance is a national goal. Over the past five years, the average annual cost to the Federal Emergency Management Agency alone has been more than $1 billion, excluding the cost of the Northridge Earthquake in the Los Angeles area. In 1996, economic damage in the U.S., as a result of weather disasters, cost $10.6 billion. To capture the intent of disaster resistance, James Lee Witt, Director, FEMA, states that "in my short time at FEMA, President Clinton has declared disasters in virtually every state. In many states, two or three times. The costs are staggering. It takes years for local governments, businesses, and citizens to recover emotionally and financially from even the smallest disasters. Years later, the impact still persists: a loss of jobs, depressed economy, and vital community resources are drawn away from investments for the future to replace the losses of the present. Many of these communities, homes, and families could have been protected through the mitigation actions that government, businesses, and citizens can take. We no longer can let this happen. The good news is that communities everywhere are taking the responsibility for alleviating the impact of disasters."

PROJECT IMPACT IN UTAH

Project Impact is a pre-disaster hazard mitigation program initiated by the Federal Emergency Management Agency (FEMA) in 1997. This program seeks to change the way America deals with natural disasters. The goal of Project Impact is to reduce the personal and economic costs of disasters by bringing together community leaders, citizens and businesses to prepare for and protect themselves against the ravages of nature. This effort is an investment that will enhance and strengthen the economic structure and long-term stability of a community, regardless of when disasters strike.

Project Impact first appeared in Utah in 1998, when FEMA selected Centerville, Davis County, to receive a $500,000 grant as seed money to mobilize an array of partnerships to enhance disaster resistance. The Utah Hazard Mitigation Officer coordinated an intensive effort with the city, State, FEMA, and many private-sector partners that ultimately accumulated over $2 million for hazard mitigation projects and activities. Centerville was selected as the FEMA Region VIII Model Project Impact Community. The Project Impact relationship with FEMA lasts for two years, during which time 19 mitigation projects are to be implemented, enhancing Centerville's disaster resistance.

In 1998, Salt Lake City, Salt Lake County, was selected by FEMA to receive a $300,000 grant to increase disaster resistance. This program is new, as of the time of preparation of this present State Hazard Mitigation Plan. It is anticipated by FEMA that three communities will be selected in each state for FY2000. For FY2000, Utah has created a set of 16 community nomination criteria to assist with the FEMA selection process and is conducting Project Impact Briefings to recruit and prepare interested FY2000 community applicants. Additionally, Utah is developing a State Support Document following presentations to key State agencies that will document State support.

One State role in Project Impact is to nominate a set of communities out of a larger grouping of applicants and to submit these nominees to FEMA for final selection. FEMA makes an official announcement of all communities nationwide at a Project Impact Summit Conference. The State then serves as a facilitator to the interaction between FEMA and the selected community(ies). The State works in three ways: 1) assist communities already selected, 2) prepare communities to apply for the following fiscal year, and 3) to coordinate public-sector resources in partnerships with the selected communities. Under these three kinds of assistance, the State Project Impact Coordinator provides a multitude of services, including documenting projects to be submitted to FEMA for approval, facilitating for Convening Workshops, preparing Community Action Plans, preparing Memoranda-of-Agreement, and advising a community

HAZARD MITIGATION GRANT PROGRAM (HMGP)

In 1989, Utah became the first community nationwide to receive the Hazard Mitigation Grant Program (HMGP) from the Federal Emergency Management Agency. The HMGP is provided to a State following a Presidential Disaster Declaration to fund 75 percent of the cost of approved post-disaster hazard mitigation projects. In 1989, following the Presidential Disaster Declaration resulting from the Quail Creek Dike Breach into the Virgin River, flooding the communities of Washington and St. George, Washington County, FEMA provided HMGP funds to Utah. These funds resulted in two main mitigation projects in St. George: 1) the Virgin River Parkway, a greenbelt project, and 2) a flood warning system on the various drainages affecting St. George. The details of these funds are explained in the State Hazard Mitigation Plan that was prepared for that disaster.

Young people using the Virgin River Parkway in St. George, Washington, County, Utah.

One expectation of FEMA is that HMGP projects will be pre-identified prior to Presidential Disaster Declarations. This present State Hazard Mitigation Plan - 1999 includes a set of pre-identified potential HMGP projects. These were identified during hazard and risk analyses developed for selected counties by the State Hazard Mitigation Officer. Although FEMA recommends having the pre-identified projects be pre-approved according to the requirements of HMGP, the length of time between Utah Presidential Disaster Declarations makes this somewhat impractical. The approval process is lengthy and detailed.

NOTE: To review the Utah Administrative Plan for the Hazard Mitigation Grant Program, see Appendix B6.

In a letter to Earl Morris, Director, Utah CEM, dated January 20, 1999, Steven L. Olsen, Director, Mitigation Division, FEMA Region VIII, made the following statements about improving program delivery for HMGP.

> "As you know, the Hazard Mitigation Grant Program (HMGP) involves a three-way partnership among local government, state government, and federal government. Each level of government must

share in the roles and responsibilities to make the program a success. The 44 CFR Subpart N explains in detail those responsibilities for each function with respect to administering the program, the components of an eligible project, and the project selection process.

The Director of FEMA has mandated that FEMA close out disasters within a two-year timeframe. This will necessitate changes in our administration of the program. Therefore, we recommend the following changes effective immediately for future HMGP activities:

- Be mindful of the 2-year closeout deadline when choosing projects. Large structural projects in a short construction season may not be practical. FEMA's preference is toward non-structural.
- Develop pre-disaster mitigation projects that are ready to be submitted once a disaster occurs, including identification of 5% projects that can be funded immediately (SHMP allows this pre-development).
- Send only complete applications. Accepting incomplete applications has resulted in significant time delays. It also gives the perception the project is being reviewed by FEMA, when in fact it has been set aside until the information is received from the state or applicant. Inevitably, once the information is received, the expectations are high that the project will be funded immediately.
- Use the HMGP benefit/cost methodology to determine whether the project is cost effective before submitting it to the region. Using one of the three HMGP computer modules would be a helpful tool. A project must have a benefit/cost ratio of at least 1:1, or the benefits to be gained from the project must be equal, if not greater than the cost of the project. Include supporting documentation of damages considered in the analysis.
- Submit quarterly reports no later than thirty (30) days after the end of the quarter.

Responsibilities of the applicant are clearly outlined in 44 CFR 10.7 with respect to the environmental process, including studies to determine the impact of a proposed action on the human environment and the required coordination with the appropriate agencies.

- Application must include FEMA's Environmental Review Checklist with attached coordination letters from local, state, and federal agencies (checklist enclosed).
- Consider selecting projects that fall within FEMA's categorical exclusion list of actions. Projects that require lengthy environmental documentation may not be completed within the two-year closeout deadline.
- If a project is selected that clearly does not fall within a categorical exclusion and the cost of the project is more than the cost of doing an environmental assessment, we strongly urge the state to withdraw the project in favor of another mitigation project. Doing otherwise would not be sound fiscal responsibility.
- Include preliminary engineering on projects with flood control or structural components in order to determine downstream impacts of the proposed project.

were rejected. Another mitigation possibility was modifying the city's golf course, which lies just beyond Stevens and Dry Canyons, into a multi-purpose flood control/recreational feature, but this was not acceptable to the community, nor was the creation of a special improvement district. A flood mitigation plan was prepared for Cedar City, but the main needs could not be met at the time. The city residents were encouraged at a city meeting and in the plan to purchase flood insurance.

Cedar City Flooding of 1989.

In 1989, the State Hazard Mitigation Officer obtained an Hazard Mitigation Assistance (HMA) Grant from FEMA to prepare a State Hazardous Materials Annex (See Appendix A2) to the State Hazard Mitigation Plan. This plan was prepared with Lorin Larsen, Utah CEM, who at the time was the hazmat program manager. A student intern from the University of Utah assisted in plan preparation. A Hazard Mitigation Team was created, consisting of four state agencies and two local agencies, and one petroleum products private-sector professional. Recommendations for hazmat training resulted that seemingly lead ultimately to the creation of the Hazardous Materials Institute, which was an original creation of Lorin Larsen. It was in this plan that the Hazard Tree Analysis method of conducting hazard and vulnerability analysis was first formally used. This was a creation of Fred May, State Hazard Mitigation Office. It still proves to be the most detailed and systematic approach to conducting hazard and vulnerability. A University of Utah hazards center course is based on it. It has been now used statewide through several counties. The hazard tree templates are created by the Utah IAT, and, therefore, have credibility in each application for each hazard (wildfire, flood, debris flow, earthquake, drought, and dam failure).

In 1989, The State Hazard Mitigation Officer coordinated the first major project under the then-new Federal Hazard Mitigation Grant Program, following the Presidential Disaster Declaration for the Quail Creek Dike Breach (See Appendix B4). This was the Virgin River Parkway, a 4-mile length of asphalt path on the banks of the Virgin River in St. George, Washington County. This involved obtaining some $300,000 in grant funds from FEMA and the Utah Disaster Relief Board. The parkway is a flood mitigation feature, where the floodplain has been reserved as a greenbelt for joggers and bicycle riders. It is a major feature in St. George. Additional funding from this HMGP grant was used for the St. George flood warning system, a set of strategically-placed real-time transmitting stream and precipitation on the Santa Clara River, the Virgin River, and the Fort Pierce Wash. This project extended into 1992.

Quail Creek Dike Breach, 1989.

On August 24, 1990, the most devastating urban wildland interface wildfire (URWIN) to have occured in Utah began just west of Heber Valley and lasted for six days, buring 2,970 acres until it was officially contained. The Wasatch mountain Fire, as it is referred to now, killed to firefighters, destroyed

18 homes, and cost the state approximately $1.42 million in fire suppression. Overall losses were estimated to be about $2 million. The Utah IAT worked on this event and generated a University of Utah Master's Thesis, entitled Vegetation Recovery and Dynamics Following the Wasatch Mountain Fire (1990), Midway, Utah, by Stephen Poreda) (See Appendix C3). The IAT also developed the term URWIN wildfire, which to our knowledge did not exist previously. The IAT also developed the concept of "Unacceptable Threat", as applied to wildfire, and the threat it poses to wildfire fighters and to residents of URWIN communities. A hazard mitigation plan was developed for the Wasatch Mountain State Park and then ultimately a grant was obtained from FEMA to develop the first State Wildfire Hazard Mitigation Plan; this was followed in 1994 by an update to that hazard mitigation plan. Another mitigation outcome of the Wasatch Mountain Wildfire mitigation planning was the development, through FEMA and U.S. Forest Service grants, of the Urwin and Wufi Children's Wildfire Mitigation Awareness Program, a children's coloring/story book that teaches wildfire awareness and mitigation. The program was piloted in Summit and Wasatch counties to third grad children. Certificates entitled "Friends or Urwin and Wufi" were presented to the school children and the children's photographs were placed in local newspapers. Top obtain a certificate, a child must take the book home and have his/her parents review it and then sign on the back page. Thus, the message gets into URWIN homes. Since that time, the Urwin and Wufi program has gone statewide and other states are using the program created through the Utah program (Urwin and Wufi created by Gary Cornel, FFSL and Fred May, Utah CEM). The Urwin and Wufi books are now being reprinted by Utah CEM through a combined grant/funding from FEMA and FFSL. The 2,000 new books should reach most third graders living in, or near, URWIN communities.


Wasatch Mountain Wildfire, 1990.

In 1990, the State Hazard Mitigation Officer, Fred May, obtained a Hazard Mitigation Assistance Grant from FEMA to develop a Debris Flow Hazard Mitigation Plan for the city of Centerville, Davis County, Utah (See Appendix C1). It is important to note this Plan served as meeting the criteria for Project Impact selection in 1998, by which Centerville is applying for approximately $500,000 in FEMA hazard mitigation grant funds. The city, on its own, also developed a Stormwater Master Plan, which also serves as a mitigation plan. The city then obtained a Flood Mitigation Assistance Planning Grant from FEMA through Utah CEM, NFIP Community Assistance Program. The HMA grant;hhowever, was the first debris flow hazard mitigation plan prepared in Utah. The plan was noteworthy in that it presented the first empirical formula for sizing of debris basins. Davis County had developed data, presented in this plan, that demonstrated that pristine canyons (those with no evidence of prior debris flows = fully-loaded canyon) in Davis County can deliver between 10 and 12 cubic yards of alluvium per linear foot of contributing channel length in a debris flow. This method provides a volume, plus the volume of the triggering event (slump or sheet erosion for a wildfire burn), to determine how large a debris basin should be for a given canyon. FEMA/NFIP accepted this volume for NFIP purposes in Davis County. The IAT reviewed both the evidence for this volume and a prior USACE debris flow volume and depth model that was developed in Davis County. The primary method for hazard mitigation for debris flows on fully-developed alluvial fans

is to construct debris basins. There is little else, if anything, that otherwise would protect people living below the mouth of a canyon that would produce a debris flow. Warning time is minimal. Debris basins are expensive, perhaps $500,000+ per basin. Still Centerville had constructed basins on Ricks Creek and Parrish Creek. The Utah Geological Survey did a study on Lone Pine Creek, and then Centerville obtained a $300,000 Community Development Block Grant (CDBG) to begin construction on a debris Basin on Barnard Creek. The city is planning to use Project Impact Funds to obtain the balance needed to construct this basin. The city is planning budgeting for a $700,000 debris basin on Deuel Creek; at that point, each alluvial fan will have "entire fan" hazard mitigation. Through Project Impact, Centerville is also planning a Bonneville Shoreline Trail (recreation plus firebreak), a watershed calibration study that will relate to a new real-time transmitting SNOTEL site and a real-time transmitting stream gage. The U.S. Army Corps of Engineers is funding a debris flow model for the Deuel Creek alluvial fan ($20,000). Several other hazard mitigation projects are underway, including the creation of a Storm Drainage Utility and larger culverts to pass under I-15 and the Denver and Rio Grande Railroad tracks; this are often backs up with springtime runoff affecting nearby residences and businesses. The Debris Flow Hazard Mitigation Plan, prepared with Centerville was provided to them in October of 1990. Eight years later, Centerville is among the first selectees for Project Impact and is considered a national roll model for Public Sector Partnerships for Project Impact.

In 1990, the State Hazard Mitigation Officer obtained a FEMA HMA Grant to prepare a Hazard Mitigation Handbook for Local Government Officials. This handbook leads a local government official through the process of hazard mitigation in his/her community. The process includes definitions, concepts, how to prepare a hazard mitigation plan, how to conduct a hazard and vulnerability assessment, and how to create a team to perform the elements of work. This handbook was distributed throughout the state and is still seen on the shelves of county emergency management directors.

In 1992, the Utah IAT created the Utah Natural Hazards Handbook (Appendix A4), which is a compendium of chapters on each major hazard faced by Utahns. This is basically a Utah Natural Hazards textbook. The handbook was used in three workshops, involving some 200 people, including 50 geotechnical engineers from the Utah Department of Transportation (UDOT). The one day course was taught by the members of the Utah IAT, with about a half hour for each lecture. This handbook has been used widely by the University of Utah Center for Natural and Technological hazards in a course entitled Natural Hazards for Urban Dwellers, a course designed to acquaint future home-buyers with natural hazards that could affect them; some 200 university students have taken this course. The state hazard mitigation officers in FEMA Region attempted to obtain a grant to create such a document in each state, but were not able to do this. Still, it is a noteworthy document.

In 1991 and 1992, the Utah IAT created the Places with Hazards education program for junior high and high school earth science programs. The objective was to educate future home buyers about natural hazards where they might chose to live or work. Each lecture was prepared by an IAT member specializing in a particular hazard. The program was developed in coordination with the State Office Education, and once the text and accompanyingf 35mm slide sets were developed, in-service instruction began for a pilot program. Following this effort, however, the Science Advisor for the State Office of Education felt that it would be difficult, if not impossible, to find the time to insert this into school curricula,

and the program could not be implemented directly. Still, the Utah Geological Survey (Sandra Eldredge) modified the texts and published them as UGS publications for earth science teachers. This publication is available still after approximately six years. Thus, the initiative is still being implemented.

In 1992, the State Hazard Mitigation Officer, Fred May, obtained a FEMA Hazard Mitigation Assistance Grant to assist Morgan County with the development of a county flood hazard mitigation plan. The design and coordination requirements for the planning, including the hazard and vulnerability assessment, were largely handled by the mitigation officer, and the field work in developing a flood history and development of recommendations were largely done by a University of Utah, Center for Natural and Technological Hazards student intern, Nancy Barr, who later was hired by Utah CEM. Other student interns were also involved. The Plan was presented to Morgan County in July, 1992, for their implementation.

In 1993, a grant was obtained by the State Hazard Mitigation Officer to assist the city of Riverdale, Weber County, Utah, with the development of a flood mitigation plan. This was largely a technical assistance effort involving the State Hazard Mitigation Officer, and student intern from the University of Utah, Center for Natural and Technological Hazards, and several members of the city of Riverdale's staff. The Plan was completed and presented to the city for their implementation. In preparing the Plan it was discovered that the city's City Hall had seemingly been recently constructed within the city's mapped floodway, which would constitute a violation of the city's floodplain management ordinance. This was addressed administratively with FEMA/NFIP and resolved to the city's benefit. The city accepted the Plan with an invitation from the Utah IAT to request implementation assistance, as needed. Through this Plan, the city became very aware of the flood threat and risk facing the community, as well as the condition of existing mitigation, and the needs for additional mitigation.

In 1994, a grant was obtained by the State Hazard Mitigation Officer from FEMA to develop a city hazard mitigation plan for Wendover, Tooele County, Utah, which had experienced recent flooding. Several IAT members assisted with Plan development, as did a University of Utah Hazards Center student intern; four state agencies and two federal agencies were involved with the community. The Plan was completed and submitted to Wendover for their implementation. A follow-up was made a year later by the same Plan developers, with an attempt to encourage Tooele County to include Wendover within the county's flood control responsibilities, but the county would not accept this recommendation. Local plans are to be implemented by local governments; hazard mitigation is generally a local government responsibility. The IAT responds to requests statewide for assistance from local governments and becomes quite occupied with many issues. Wendover was presented with the plan for their implementation with an invitation to request further assistance from the IAT, as needed.

In 1995, The State Hazard Mitigation Officer prepared a Hazard and Risk Assessment Handbook for the Utah IAT. This handbook identifies how hazard and risk terminology is used by professional hazard workers and the methods they use. This information has been of value because terminology is used in a variety of ways. The IAT has become long-term professionals in field hazard mitigation activities. The handbook has been used in IAT training.

In 1992 to present, the State Hazard Mitigation Officer worked with the University of Utah, Department of Geography, to create the University of Utah Center for Natural and Technological Hazards (C^{nth}). This was created as a coop program between Cnth, Utah CEM, and FEMA. FEMA allowed C^{nth} to offer FEMA Training Certificates to students completing a particular curriculum. Certificates are still offered in Disaster Reduction Planning, Hazards Reduction Planning, Earthquake Hazards Reduction Planning, and Disaster Information Management and Forecasting (DIMF). The DIMF program meets the criteria of the Global Disaster Information Management (GDIM) program as defined in a booklet by Al Gore, Vice President of the United States, Office. DIMF is a new certificate program at C^{nth}, involving laboratories where students learn to use electronic data bases to manage disaster information and do forecasting. The C^{nth} program has graduated more than 70 students, and approximately twenty are presently involved in the full program. Students in the program must complete a two-credit-hour internship, generally through Fred May at Utah CEM. This is the main element of the C^{nth}/CEM/FEMA coop program. Over the years, student interns have developed a myriad of timely projects for IAT or State Hazard Mitigation Program use. For example, one student, following the Provo Microburst Emergency prepared the first statewide wind-velocity-record tables (many cities in Utah). Another intern prepared a booklet instructing the IAT how to rapidly construct GIS maps in the field, using ArcView II on a laptop.

In 1996, the State Hazard Mitigation Officer (also titled the Utah Interagency Technical Team Coordinator) was tasked with creating an IAT to address reentry considerations following a chemical weapons accident at Deseret Chemical (Tooele Army Depot South Area). The new IAT consisted of a variety of State and local government officials, especially staff from the Department of Environmental Quality, Division Solid and Hazardous Waste. The objective was to create reentry criteria for the Tooele County Commission (for decision-making purposes about reentry) and for CEM, DEQ/SHW, and others. The IAT created sets of tables with checklists and reentry considerations for all kinds of contamination surfaces. The tables were accepted by the county , DEQ, and CEM and serve as part of the reentry plan.

In 1998, the State Hazard Mitigation Officer, Fred May, was invited by FEMA (Mike Armstrong, FEMA, Deputy Director for Mitigation) to come to Mt. Weather, Virginia to assist with testing and developing State training materials for the new National Emergency Management Information System (NEMIS). The SHMO created a set of about 30 process charts that was printed at FEMA Headquarters and distributed for review. These process charts graphically display how a State Hazard Mitigation Officer electronically process hazard mitigation grant applications following a Presidential Disaster Declaration, as part of the Hazard Mitigation Grant Program (HMGP). Fred May was then invited to attend the NEMIS Train-the-Trainer Pilot Course at FEMA's Emergency Management Institute, to learn to assist with training State counterparts in NEMIS. The document produced is touted by FEMA as valuable in State training activities. Fred May was then invited back a second time for NEMIS training.

From 1995 to the present, the IAT has developed and applied several disaster templates for conducting local hazard and vulnerability analyses. During this period of time hazard and vulnerability analyses have been conducted for several counties in Utah and for a variety of hazards. These analyses serve as the bases for mitigation plans, incorporating hazard mitigation recommendations. Planning at present is being conducted for a State Drought and Flood Mitigation Plan; a Mendon, Cache County, Flood Mitigation Plan (first flood mitigation plan probably nationwide) to deal with flood threat from an

aging irrigation canal uphill from newly developing subdivisions and also the older community of Mendon. Planning is also being conducted for Spring City, Sanpete County, for debris flood threat to one of the nation's two historical communities (National Historic Register): Spring City, Utah, and Colonial Williamsburg, Virginia.

From 1995 to the present, the IAT set about to create ONSITE Reports that document the onsite field hazard/vulnerability analysis and mitigation planning activities of the Utah Interagency Technical Team. This IAT consists of technical representatives of ten state and ten federal agencies. The IAT has worked on emergencies statewide in numerous communities that lack technical expertise to understand and deal with natural hazards that face them. The IAT is activated, at the request of the County Emergency Management Director, when a community has a concern about a natural hazard or when they have an emergency caused by a natural hazard. The ONSITE Reports, contained in Appendix One, serve as one source for the recommendations contained in this State Hazard Mitigation Plan. These reports, and other IAT statewide experience, provide the experience through local government interaction to identify the needed statewide recommendations. Other recommendations in this plan are selectively-retained from the State Hazard Mitigation Plans of 1983, 1984, 1986, and 1989. Other recommendations are retained from the several local hazard mitigation plans prepared over the course of the past ten years. The ONSITE Reports; however, contain the actual ground experience of the IAT with observations of what kinds of mitigation would be most valuable. It is again important to stress that not all possible mitigation is reasonable and justified. Recommendations are included that relate to events up to a possible 100-year frequency.

From 1995 to the present, the Utah IAT has actively coordinated between local governments and the Natural Resources Conservation Service to provide emergency, and long-term mitigation project funds to local governments. The IAT serves as the technical advisors to local governments who lack the required kinds of expertise (hydrology, geology, environmental science, and biological science). In this capacity, the IAT recommends mitigation projects for the impacted community to the NRCS and that agencies Emergency Watershed Protection Program. This coordination has resulted in over a million dollars in mitigation funds going to local governments. Additionally, the IAT advises local governments on obtaining State Community Impact Board grants and Community Development Block Grants (Emergency Funds and long-term project funds).

During 1998, the Utah IAT has assisted Centerville, Davis County, Utah, with mitigation efforts related to Project Impact. Primarily following Centerville's announcement by FEMA as the Utah Project Impact selection for FY98, the IAT assisted Centerville with mitigation measures to match the city's chosen needs. The IAT identified several projects for Centerville that would meet their chosen needs, such as: 1) the Bonneville Shoreline Trail (firebreak), 2) the watershed calibration study, 3) a Parris Creek NRCS SNOTEL Site, 4) a USGS stream gage on Deuel Creek, 5) a Deuel Creek Debris Flow Model (FLO-2D), and assistance with the design and requirements for a Barnard Creek Debris Basin. Besides these structural (or related) measures, the IAT Coordinator, Fred May, has coordinated state, federal, local, and volunteer agencies in creating a compehensive education package and financial incentives package for Project Impact in Centerville. FEMA indicates that the Utah IAT involvement is likely the best in the nation for Project Impact in FY98. As an example of extra efforts for Centerville, the Utah IAT produced the only community video documentary nationwide for Project Impact application. Involvement included the Utah

Division of Wildlife Resources donating their video editing studio to prepare the documentary. The Utah IAT Coordinator also developed the nomination form used for Project Impact in FEMA Region VIII, and the Project Application forms to use for ultimate Project Impact project application.

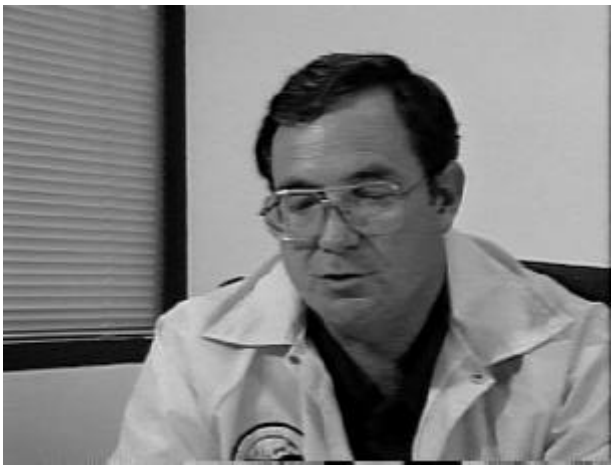
During 1998, The Utah IAT Coordinator, also titled the Utah Project Impact Coordinator, proceeded at FEMA's direction to begin the FY99 round of Project Impact, to select three prioritized nominees and pass them on to FEMA for final selection within about five weeks. The five week deadline required the development of an application package, placing it on the internet, giving an address on the application process to the Utah League of Cities and Towns (approximately 700 people present), creating an electronic application package for e-mail transmission, creating the first step-by-step Project Impact community process (9-step process) known by FEMA Region VIII, and to begin communicating with interested communities. The IAT Coordinator met with the Utah IAT to review the selection criteria prior to developing the application package. The package was disseminated to the Utah CEM Mitigation and Planning Section and to management for review. The Utah IAT was requested to be the primary committee for FY99 community nomination, along with the Utah CEM Mitigation and Planning Section; Utah CEM County Liaisons were also invited to participate as their time permits. These efforts were being done simultaneously with required coordination with Centerville and their several committees and FEMA interactions.

During the 15 years of service, the State Hazard Mitigation officer, has provided to Utah CEM, the IAT (also derived from the IAT) and local government emergency managers, a weekly statewide flood potential report (See Appendix Two; examples). These products keep State and local officials aware of weekly flood potential during the spring snowmelt runoff period, but also during the monsoonal flood season, as needed. With the advent of electronic data bases on the internet, the development of a statewide flood potential analysis has become much easier and more complete. The ability to examine historic records has been of great value to compare percents of normal snow water equivalents for the same day in different years. For example, 1983 was Utah's major flood year of record, and it is possible to compare day-by-day from this present year to that year.

From 1996 to present, The State Hazard Mitigation Officer/IAT Coordinator, Fred May, and the IAT worked with drought mitigation projects and planning primarily in San Juan and Garfield Counties, and to a less detailed extent statewide. The IAT Coordinator obtained approximately $200,000 in drought mitigation planning grants for these two counties from the U.S. Bureau of Reclamation (BoR) then obtained some $90,000 in drought mitigation planning grants from the BoR. This $90,000 was distributed as follows: $35,000 to San Juan County for development of a County Water Plan; $35,000 to Garfield County for a related planning project of their choice; and $20,000 to the State IAT Coordinator to coordinate development of county drought mitigation plans for each of the two counties and then ultimately a statewide plan. The BoR; however, requested that the drought mitigation plan also include flooding. Thus, the plan is a spectral plan addressing too much water and too little water. The State IAT Coordinator attended two weeks of Drought Mitigation Planning Training, at Albuquerque, New Mexico, and at Salt Lake City, Utah, presenting a report on the concept of Spectral Planning with the State Climatologist, Dr. Don Jensen. The development of drought disaster templates used to gather data/information through a detailed interview process in the impacted areas has now been adopted by the National Drought Mitigation Center (NDMC)

at the University of Nebraska at Lincoln. Dr. Mike Hayes traveled to Utah to view the interview process being used in Garfield County. Dr. Hayes indicates that although many drought response plans exist nationwide, that the IAT Coordinators efforts are likely the first State Drought Hazard Mitigation Plan ever developed; additionally, the Plan contains flood hazard mitigation, as well. This present Plan (this present text) serves as the basis for this updated State Hazard Mitigation Plan, emphasizing hydrologic hazards (flood and related events, and drought events).

During these total of 15 years as Utah Interagency Technical Team Coordinator, the State Hazard Mitigation officer also attended some 500 hours of training at FEMA's Emergency Management Institute (EMI) at Emmitsburg, Maryland. The Utah IAT also received training at EMI. Additionally, the Utah IAT Coordinator instructs Utah CEM Hazard Mitigation Courses, trains local officials in the new emphasis in emergency management, hazard mitigation.



State Hazard Mitigation Officer, Dr. Fred May, maintains the State Hazard Mitigation Plan and coordinates field mitigation for Utah Interagency Technical Team.

STATE HAZARD MITIGATION PROGRAM (SHMP)

State Hazard Mitigation Officer

(Hazard Mitigation Recommendations)

This section discusses the role of the Utah State Hazard Mitigation Officer in conducting the State Hazard Mitigation Program. The State Hazard Mitigation Officer (SHMO) is also titled the Interagency Technical Team Coordinator and the Utah Project Impact Coordinator. The following information is derived from the FEMA guidelines for conducting a State Hazard Mitigation Program. It is important to note that the SHMO position in Utah (and all states) is funded 100 percent by the FEMA.

NOTE: This section contains a summary of the State Hazard Mitigation Program. The details are contained in Appendix A10.

The State Hazard Mitigation Program is funded by the Federal Emergency Management Agency (FEMA) on a 75-25 cost-sharing ratio. The program requires hiring a full-time State Hazard Mitigation Officer, maintaining a State Hazard Mitigation Plan with its annexes, maintaining the equivalent of a State Hazard Mitigation Team, and maintaining a State Administrative Plan for the Management of the Hazard Mitigation Grant Program.

State Hazard Mitigation Plans are a requirement of receiving Federal Disaster Assistance, following Presidential Disaster Declarations. Utah received Presidential declarations in 1983, 1984, 1986, and 1989 and plans were prepared following each event. The last Presidential declaration was in 1989, a decade ago at the time of preparation of this present plan. In the meantime, several hazard annexes were prepared,

often resulting from an emergency event in Utah.

State Hazard Mitigation Plan:

In a letter to Earl Morris, Director, Utah CEM, from FEMA Region VIII, dated February 8, 1999, Steve L. Olsen, Mitigation Division Director, indicated that:

> "As you are aware, planning is an important part of the mitigation process. It is, in fact, required by 44 CFR, Section 406, Subpart M. The general approach of 44CFR is that a state should develop a basic mitigation plan before a disaster occurs and then update it either annually or after a disaster. There are different ways to accomplish the same goal which is good, solid mitigation planning.
>
> You should have received a copy of the draft 409 Planning Checklist that FEMA HQ has prepared for use in developing and reviewing 409 plans. It is currently in revision before being put out for general use by all the state and region staffs. There are some good ideas in the checklist, and we hope it will be helpful in your plan development and/or revision.
>
> After reviewing several plans, and with the new emphasis on the 409 checklist, we believe that changes to the 409 planning process need to be made. We must make it more user friendly, less cumbersome, less burdonsome on staff, and more informative. The approach we are suggesting is as follows:
>
> 1) Start with a basic statewide all-hazards mitigation plan that is reviewed and update annually (preferably during non-disaster times). This would incorporate a hazard analysis, state mitigation goals, and state mitigation strategies to achieve the goals. With the new advances in GIS technology, you could also put into the plan GISD maps showing risk areas, population impacts, demographic information, and geography, etc. This would be the "big" plan. You will probably want to coordinate with your state mitigation team members for input on their areas of expertise. This effort will also complement the requirements for Project Impact and provide ytour state with one umbrella mitigation plan.
>
> 2) After a disaster declaration, there will be a 15-day report (or something similar to it) developed by the Interagency Team. This should include the basic description of the disaster, the causes, and recommendations developed by the Team. The state mitigation team would then develop a "short" (5-10 page_ "Mitigation Strategy" document describing the strategies the state would use to mitigate that disaster. This should complement the strategies in the State Mitigation Plan and support the 15-day report. Through that process the state team may also develop refinements to the overall state strategies for incorporation into the basic plan.
>
> 3) Within two years of the disaster declaration, the state would develop an After Action Recommendations Report for use by the state and this office, describing the mitigation

work accomplished, lessons learned, and recommendations for improvements of the mitigation process in the state. The report does not have to be long. It will serve as an update in conjunction with the annual approval of revisions to the Plan. My Mitigation Specialist will be available to provide technical assistance.

By using the above steps, you will meet the 409 requirements under 44 CFR and save yourself valuable staff time. We know that having to write a 409 plan within 180 days after a disaster, which is the busiest time for the HMGP process, is very difficult to do. With this approach, you don't have to do it. The plan is already in place and approved. You just implement it, using strategies identified with each even and then inform others of the results of your efforts through the After Action Recommendations Report.

As I described earlier, this is a new approach to the planning process. We would appreciate any comments on this approach. If the timing is wrong for your current planning cycle, please feel free to consider implementation of the process in your next cycle."

Hazard Mitigation Recommendations:

The goals contained in this section also constitute hazard mitigation recommendations, in that they identify tasks to be accomplished by the State of Utah toward hazard mitigation. Thus, in reviewing them, the reader should be aware that these goals also fall under the recommendations section of this State Hazard Mitigation Plan. The same holds true for the section describing the goals of Project Impact.

SUMMARY OF UTAH SHMP:

Project Impact and NEMIS have become emphases within the State Hazard Mitigation Program (SHMP) in Utah. Project Impact does not create, so much, a new program within the SHMP, but a direction of focus, or an approach to conduct the SHMP in Utah.

The following task-related items are taken from the Federal Emergency Management Agency, FY 1999, Cooperative Agreement, Guidance, and each is addressed for 1) goals, 2) strategies, and 3) objectives, as outlined on the CA FY 99 Worksheets.

Utah retains a full-time State Hazard Mitigation Officer as a focal point for hazard mitigation activities such as: 1) conducting an all-hazards risk assessment, 2) committing to strategic goals which will support tangible mitigation objectives, and 3) setting in-place processes for working with other State agencies and communicating to identify, develop, and administer mitigation projects and generally enhance State and local mitigation capability.

The Mitigation Assistance Program (MAP) provides financial assistance to States to develop and maintain a comprehensive Statewide hazard mitigation program. It is recommended that each State designate a qualified full-time State Hazard Mitigation Officer (SHMO) who can assume the responsibilities that come with the agency's leadership role and to coordinate State mitigation activities. Program activities would include comprehensive mitigation planning; interagency coordination; development of procedures for grants

administration and project evaluation; provision of technical assistance to local governments; and annual progress reviews. Recommended duties would include chairing an interagency mitigation coordination committee (e.g., Utah Interagency Technical Team), which would lead Statewide mitigation planning and project identification, and prioritized use of Federal and State project grant funds.

In most states, the State Hazard Mitigation Officer coordinates **Project Impact** for a variety of state-related tasks, including training of state officials, information development and dissemination, development of training packages, provide technical assistance, developing a forum of state agencies to implement Project Impact, and to coordinate and communicate with FEMA Region.

Utah has been involved considerably with the development, testing, and training for **NEMIS** (National Emergency Management Information System) and will continue to assist FEMA in these activities, such that Utah can be well prepared to implement the Hazard Mitigation Grant Program (HMGP) in the event of a major disaster.

IAT accomplishments draw a definite parallel with the National Mitigation Strategy, emphasizing Project Impact and NEMIS:

1) Develop, support and conduct ongoing public information on natural hazard mitigation.
2) Conduct risk assessment of public property for corrective actions.
3) Develop mitigation plans and identify resources to support them.
4) Develop linkages between government agencies and encourage coordination of resources for mitigation projects.

GENERAL GOALS OF THE SHMP (Hazard Mitigation Recommendations)

A listing of goals for FY 99 are also listed below.

The full-time State Hazard Mitigation Officer (Utah) will develop and maintain a comprehensive hazard mitigation program to:

1) **Centrally Coordinate State Hazard Mitigation Activities:** Provide one recognized source for hazard and risk analysis, planning and implementation that is familiar to State agencies and local governments. This source is the State Hazard Mitigation Program (SHMP) which includes the activities of the State Hazard Mitigation Officer (SHMO) and the Interagency Technical Team (IAT) (=State Hazard Mitigation Team and the Field Advisory Support Team). Project Impact will be an emphasis-vehicle in Utah to accomplish this, and the State Hazard Mitigation Officer will serve as Project Impact Coordinator for Utah. Hazard mitigation is a new concept to many local governments and risk is still considerable statewide. At the State level, there is the need to provide statewide planning and implementation from a central source.

2) **Conduct Comprehensive Multi-hazard Mitigation Planning:** Reduce the potential for major impact

in Utah from natural hazards. Utah's mountainous terrain and varied climate produces many kinds of potentially-dangerous natural hazards and they create much risk for Utah's nearly two million people. Comprehensive statewide planning has proven successful in the reduction of risk and will continue to reduce risk across the state from the local to the State level. To prepare potential Project Impact communities, or an array of communities pursuing Project Impact objectives, The SHMO will assist local government in multi-hazard mitigation planning, involving the Interagency Technical Team, as is possible, as a technical assistance resource.

3) **Interagency Coordination**: Have a well-trained Interagency Technical Team (IAT), including the Team's coordinator, that can assist with the planning, implementation, and technical assistance needs of the State and its local governments, especially as it relates to Project Impact objectives.. The need has been apparent for several years because State agencies and local governments know that they can call on this cross-trained Team to address hazard awareness and mitigation needs. IAT members will be involved selectively, generally first involving a small advance Team and then a larger Team, if necessary. If an obvious major emergency/disaster is emminent, then a larger Team component will be sent.

4) **Development of Procedures for Grant Administration and Project Evaluation**: Maintain a current HMGP Administrative Plan to facilitate an efficient implementation of the HMGP when needed. Continue to be involved with the development and implementation of NEMIS, as it relates to future potential Utah disasters. Develop training in NEMIS by assisting FEMA with NEMIS deployment in other states, as time permits. The need exists because of the potential for major disaster in Utah and the associated need of providing rapid and efficient implementation of the HMGP to reduce risk in the State and its local governments.

5) **Provide Interagency Technical Team Assistance to Local Governments**: During times of emergency or concern about natural hazards the Team must be capable of properly identifying risk and mitigation needs for local governments. The need exists because local governments often do not have the trained technical staffs to evaluate the potential threats from a hazard nor the associated risks. Rapid evaluations can save lives and apply a technical perception of threat and risk. During these IAT activations, Project Impact concepts will be introduced to the impacted communities.

6) **Provide Annual Reviews for Local Governments:** Assist local governments in their mitigation efforts to maintain consistency in risk reduction in Utah. The need exists because in the pre-disaster time frame, the priorities for implementation can change unless the emphasis is maintained, which the Interagency Technical Team can do by providing reviews for local governments.

7) **Have a Well-Trained State Hazard Mitigation Officer:** The State Hazard Mitigation Officer must be able to lead the Interagency Technical Team, as needed, to conduct an exemplary/effective comprehensive Statewide hazard mitigation program. The need exists because the Interagency Technical Team requires a knowledgeable generalist, such as in the physical and biological sciences, to balance and direct Team members (engineers, geologists, environmental health specialists, etc.) involvement, and to provide the Team members with methods in hazard and risk analysis, planning, and implementation.

EXPECTED RESULTS OF THE SHMP:

Through the implementation of this proposed statement of work for the State Hazard Mitigation Program (SHMP), state and local entities will participate in a uniform approach to hazard mitigation, now known as Project Impact, with the objective of becoming disaster resistant communities (and state). The application of NEMIS (electronic management of disasters) within Utah will facilitate the rapid/efficient processing of hazard mitigation grant applications. The orientation of the Utah Interagency Technical Team (IAT) will be toward developing disaster resistant communities, which takes their efforts toward a higher goal beyond technical assistance. As this program becomes embedded in Utah communities, Utah will become more disaster resistant. It is important to note that Utah continues to benefit from its excellent history of hazard mitigation, being in the bottom four states in the nation in numbers of Presidential Disaster Declarations.

THE UTAH INTERAGENCY TECHNICAL TEAM

The Utah Interagency Technical Team (IAT) consists, in reality of two teams. The first is the State Hazard Mitigation Team, consisting of State agency technical personnel, and the second is the Field Advisory Support Team (FAST), consisting of technical staff of Federal agencies and universities. Together, these people have the expertise to understand most hazards and to effectively advise local governments during times of concern about natural hazards and during emergencies. In reality, the name by which such a team is most commonly know nationwide would by the Interagency Hazard Mitigation Team (IHMT).

NOTE: To view the IAT rosters and information on team members please see Appendix A13.

The Utah Interagency Technical Team was created formally in February 1988, when then Commissioner of Public Safety, John T. Nielsen, sent letters to several State agencies requesting that they provide one or more team members to represent their agencies on this team. The letter read:

> "The State Division of Comprehensive Emergency Management (CEM) is required by both Federal and State law and/or agreements to use "interagency teams" to coordinate emergency management within the State, including hazard mitigation. This letter requests that you select two team members from ytour agency for the State Hazard Mitigation Team, a multi-agency team organized to provide managers with perspectives on Utah hazard mitigation and to develop and help implement the State Hazard Mitigation Plan. This Team is separate from the State Agency Response Team also used by CEM during emergencies. The Team does not create policy. The State Hazard Mitigation Plan contains an ongoing and changeable array of recommendations designed to reduce the threat from Utah'[s hazards. Team members must be technically-qualified and have authority to represent their agency in developing the Plan.
>
> "Responsibilities and rationale for the team are explained on the next few pages. The Hazard Mitigation Team consists of agencies that do planning engineering, engineering design, or work on hazards to

mitigate them. Advisory Agencies for the Team provide provide input to the Team for either hazards identification or potential impact.

"The time commitment for Team members will be a few hours per month, plus additional time should a disaster strike. Have your selected team members contact Fred May, State Hazard Mitigation Officer, at 533-5271, as he will need to meet with them."

The resulting Team consisted of, and still consists of, representatives of the following State agencies:

Utah Department of Agriculture
Utah Department of Transportation
Utah Division of Environmental Response and Remediation
Utah Division of Forestry, Fire and State Lands
Utah Division of Parks and Recreation
Utah Division of Water Resources
Utah Division of Water Rights
Utah Division of Water Quality
Utah Division of Wildlife Resources
Utah Geological Survey

The Utah Field Advisory Support Team (FAST) was created in 1990 to provide back-up to the State Hazard Mitigation Team. This team is part of the Utah Interagency Technical Team (IAT) and is also coordinated by the Utah Division of Comprehensive Emergency Management. FAST is a team of technical representatives from the Federal government and universities that can activate quickly for brief periods to assist local governments and the State in performing the following functions:

1) Assist the State Hazard Mitigation Team in hazard mitigation planning and field hazard and risk assessment activities.

2) Interact with State field teams, meeting with local government officials to advise them about hazards that may be causing concern for the city, county, or area.

3) Meet with State officials during times of concern about hazards to advise them on hazard and risk.

4) Provide onsite hazard and risk assessment during and after times of emergency or disaster.

Federal Agencies represented on the Utah FAST include the following:

Natural Resources Conservation Service - Emergency Watershed Protection Program
Natural Resources Conservation Service - Utah Snow Survey Office
Natural resources Conservation Service - Resource Conservation and Development Program
U.S. Geological Survey - Utah River Gage Program
U.S. Army Corps of Engineers - Utah Planning Office

National Weather Service - Salt Lake City Office, including the Colorado Basin River Forecast Center
Utah Avalanche Forecast Center
U.S. Bureau of Reclamation - Provo Area Office
U.S. Forest Service

Universities involved with the Utah IAT:

University of Utah:
Department of Civil Engineering
Department of Geography

Weber State University:
Department of Geology

In reality, the Federal government and area universities often have as great an interest in Utah hazards and emergencies as does State government. Members of FAST represent programs that normally do deal with Utah hazards. Thus, it works well, and is natural, for the overall Utah IAT to be comprised of both State and Federal team members. On team activations, both components are equally-represented.

5) Interact with Federal Interagency Hazard Mitigation Teams (National) in field activities during times of Presidential Disaster Declarations.

Acceptance of Utah IAT by Federal Emergency Management Agency:

On June 12, 1997, Sherryl Hahl, Chief, Hazard Mitigation Branch, FEMA, Region VIII, wrote the following to the Utah State Hazard Mitigation Officer.

"I thought I would take this opportunity to let you know that the technical assistance your IAT has provided not only is a priority of the Hazard Mitigation Program but is a basic management tool for mitigation activities. What is more important is the mitigation direction of emergency management given the new funding sources to back that up. Finally, I looked at the National Mitigation Strategy again and I believe that the IAT accomplishments can draw a definite parallel from the following covered in the National Mitigation Strategy.

1) Develop, support and conduct ongoing public information on natural hazard mitigation.

2) Conduct risk assessment of public property for corrective actions.

3) Develop mitigation plans and identify resources to support them.

4) Develop linkages between government agencies and encourage coordination of resources for mitigation projects.

The bottom line is that your team has been in the forefront with the training, technical assistance, planning, and on-site assessment. We can only push forward with the mitigation agenda so that in time the local officials, non-profit and volunteer groups and the private sector understand and do their part in reducing disaster losses."

On October 6, 1998, the upper management of FEMA Region VIII wrote the following letter to Earl Morris, Director, Utah Division of Comprehensive Emergency Management regarding the successes of the Utah IAT, following the IAT's first decade of service.

"It has come to our attention that the Utah Interagency Technical Team (IAT) is completing its first decade (1988 - 1998) in serving the residents of Utah in the areas of hazard and vulnerability analysis and hazard mitigation. Please convey our congratulations to the participating IAT agencies.

We compliment the Utah IAT for exemplary accomplishments in the areas of interagency coordination to protect the residents of Utah. As we have said to the Utah IAT over the years, Utah sets a national standard in pre-disaster and emergency interagency coordination and local government interaction in the many areas of hazard mitigation. It is for this purpose that the Federal Emergency Management Agency (FEMA) asked Dr. Fred May to come to Idaho in 1997, during their Presidential Disaster Declaration, to organize such a team. The results were successful; as documented in the letters sent to your office by both FEMA and the State of Idaho. The Utah IAT has assisted local governments with rapid technical assistance over the years, resulting in the many ONSITE reports(including mitigation planning), which from our national perspective is something that few other states have mastered. The extensive involvement of the Utah IAT in Project Impact has been most impressive, again setting a national standard.

The interagency coordination led by Dr. May through the Utah Division of Comprehensive Emergency Management, Department of Public Safety, demonstrates the needed governmental partnership to assist with the success of the Utah IAT. This has proven to be an ideal relationship statewide.

FEMA supports and encourages you in your efforts as you approach your second decade in providing to your State what we deem to be highly successful actions in pre-disaster hazard mitigation, primarily to local governments through interagency team coordination."

UTAH NATURAL HAZARDS

Utah has not proven to be significantly disaster-prone since the early to late-1980s, when Utah experienced four Presidential Disaster Declarations. In all, Utah ranks in the bottom four groupis of state in terms of numbers of Presidential Disaster Declarations (Texas, California, and Florida are the top three). Still, since the 1980s, Utah has experienced numerous local emergencies, largely due to flood, or flood related hazards (debris flows). In 1998, northern Utah experienced a sequence of landslide events with some damage to homes. Wildfire is an ongoing active hazard, costing the State millions of dollars per year in response activities. The St. George Earthquake in 1992 caught the State's attention. It caused a landslide in Springdale, Washington County, which destroyed three homes, partially blocked SR9 and threatened the Virgin River. Still, through all of Utah's disaster and emergency events of the 1980s and 90s, no lives were lost from flood events, none from earthquake events, and two lives from wildfire events. There were numerous near-misses, in terms of lives lost, and we must count ourselves fortunate that situations happened as they did, and where they did.

This present State Hazard Mitigation Plan is based largely on the events experienced in the years since 1989, when we had our last Presidential Disaster Declaration. Much mitigation occurred in, and following, the years of the Presidential Disaster Declarations. The 1990s, therefore, represent a new plateau in disaster resistance relative to the typically-experienced hazards. Utah has not yet been tested with larger frequency events, and even in the 1980s, Utah is not thought to have experienced 100-year events for any natural hazards. There is vulnerability to all major natural hazards in Utah, and certainly the 100-year events, when they do occur are anticipated to likely cause loss of life and property.

This Plan is largely a plan dealing with flood and flood-related hazards, although a set of recommendations are included dealing with geologic hazards. These were provided by the Utah Geological Survey and extracted selectively from the 1983 Governor's Conference on Geologic Hazards, which were included in the Utah 1983 Hazard Mitigation Plan.

Drought hazard is also included in this present hazard mitigation plan. In 1996, several Utah counties were included in a national drought emergency with the main impacts occurring in San Juan and Garfield Counties. The U.S. Bureau of Reclamation coordinated a drought response and planning program under Public Law 102-250, Reclamation State Emergency Drought Relief Act of 1991. As the Utah Division of Comprehensive Emergency Management (CEM) became involved with San Juan and Garfield Counties during the 1996 drought period, the State Hazard Mitigation Officer/Interagency Technical Team Coordinator, processed applications for funding for both projects and planning under PL 102-250. As a result, $94,000 in planning funds and approximately $300,000 in project funds were received by the impacted areas. This present plan is being prepared under funds from both FEMA and the BoR, along with detailed plans for San Juan and Garfield Counties (prepared separately from this State plan). The State Plan is based largely on the planning experience for San Juan and Garfield counties, as that experience applies statewide. Also, information was solicited from each county Utah State University Extension Agent

and Emergency management Director for inclusion in this plan. That information is included under its own Section further ahead in this Plan.

UTAH NATURAL HAZARD ANALYSIS

County-by-county details of the flooding of 1983, 1984, and 1986 are contained in those respective State Hazard Mitigation Plans, which serve as appendices to this Plan. Please refer to those documents for the details on flood and other experienced hazards. Those documents portray what nature did in those counties under wet climatic cycles and are a reasonable presentation of vulnerabilities and impacts. Since that time, however, much mitigation has occurred and our sense of vulnerability at the present time results from the experiences of the past decade. The flood experiences of the past decade have been related largely to flash floods and debris flows generated by monsoonal thunderstorms which, thus far have struck mainly rural areas. These events are difficult to understand in terms of frequency, due to the lack of monitoring stations in rural areas. It is assumed that these events are often greater than 100-year events, and such events are difficult to plan for and to mitigate against. Still, these events do generate much interest in mitigation and work is accomplished. Fortunately, there is considerable coverage now in Utah with Doppler Radar, which gives some capability with issuing weather advisories, giving local governments some opportunity for emergency mitigation and response. In all, under these circumstances, it is difficult to conduct a statewide natural hazard analysis for flash flood and debris flow, other than to note the widespread potential and vulnerability.

The greatest sources of historical knowledge about flash flood and debris flow, or other related kinds of events, are: 1) the ONSITE Reports of the Utah Interagency Technical team. The ONSITE report for 1997 and 1998 are contained in Appendix A1, and 2) the city and county hazard and risk analyses developed by the Utah Interagency Technical Team (IAT) found in Appendix A14. Not all county analyses are completed, but several are and these give us some insight into Utah's vulnerabilities. In addition, the lack of events in some counties over the past decade also gives us some insight into Utah's situation relative to vulnerabilities. This is not to say that events cannot happen statewide, but only provides a measure of what typically happens over a decade. All of Utah's rivers and streams will eventually experience a 100-year event. In many cases we know the geographic extent of such flooding, and in some cases we know the details of the elevations of the anticipated 100-year floods and the numbers of structures to be involved.

NOTE: The county hazard and risk analyses are summarized below, beginning with those conducted in northern Utah.

The U.S. Geological Survey maintains tables of flood discharges for the typical flood frequencies for several of Utah's rivers and streams. In fact, USGS data are often the definitive data accepted by FEMA and the National Flood Insurance Program, (NFIP) because these figures are updated annually as ongoing USGS river gage data accumulates. The National Weather Service maintains data on discharges at bankfull and flood flow for many of Utah rivers and streams. The Natural Resources Conservation Service (NRCS) has conducted floodplain studies for selected communities and areas, as does the U.S. Army Corps of

Engineers. In all, there is a very useful body of data that enables us to understand the magnitude of flooding in many areas of the state, when it does occur, and in other case there is also a body of data that enables us to understand what is at risk for events, up to the 100-year flood event.

The State Water Plan, for the various main Utah drainages provides us with water supply and use data, but provides little data or information on flood risk in those drainages. Typically, plan contents addressing flood and drought threat and risk may comprise four paragraphs with only general statements. Still, these plans provide much valuable information on water supply and use in these drainages. plans complement county water plans (not all counties have water plans) and provide more information on flood risk.

NORTHERN UTAH HAZARD AND RISK ANALYSIS

Flood: The high mountains of the Wasatch Mountains and related Basin and Range and the Uinta Mountains provide abundant snow. The snowmelt window typically extends from March into June, and as the snow becomes more dense and melts at increasing rates, flood potential escalates. In most cases, even threatening scenarios of snowmelt relent and reasonable runoffs result. It is not common for runoff to produce overbank flooding, where damage to homes and businesses result, as generally northern Utahns discover that the spring flood potential subsides. Still, there is a point at which the situation could escalate and this is monitored closely using the array of SNOTEL sites, USGS river gages (data collection platforms), NWS river gages (LARCs), NWS weather reports and flood advisories, and State Climatologist Utah Climate Update Reports.

Rich County: Debris flows have not been a problem, and the only location of threat is in the remote Monte Cristo area. The rivers that present potential flood concerns are the Bear River, Little Creek, and Woodruff Creek. The Bear River flows about two miles west of Woodruff and Randolph. At risk are mainly a few ranch houses. Few crops are raised, only meadow hay. There sis no cultivated land at all. In 1983, the Bear River flowed up to the ranch houses, but none were damaged significantly. Woodruff Creek flows through Woodruff, but first passes throuigh Woodruff Reservoir, where there is flood storage. This creek has not flooded causing significant damage. Little Creek flows around the outside of Randolph and flows through agricultural land. There is no real threat as there are no tilled crops. There appears to be minimal threat to both residential and commercial property on any of the streams. There is also minimal threat to utilities and other pipelines. There are dams within and outside of the county that could affect the county if the dams were to fail. These are Woodruff Narrows, Birch Creek, and Little Creek reservoirs. Woodruff Narrows would affect the city of Woodruff, then flow into the Bear River. This flood would likely miss the city of Randolph.

Cache County: Locations vulnerable to debris flows include: Logan Canyon, Blacksmith Fork, Birch Creek/Smithfield Canyon, and generally all of the steep canyons. High flows on rivers are experienced on the Logan River, Blacksmith Fork, and Birch Creek. Bank sloughing can be a problem on the Bear, Little Bear, and the Lower Blacksmith Fork Rivers. In these areas, trees and debris can fall into the river and constrict flows. Constricted flows occur at the county bridge in Nibley and on the Little Bear

on Mindon Road and in Clarkston by the cemetery. There are few areas where residential property is threatened by high flows. There is also little threat to commercial property, except for the Logan Golf Course. Most of the flood threat from the four main drainages is to agricultural land, but this is mainly non-cultivated pasture land. Conduits have plugged on Mindon Road and there are four crossings on the Little Bear where plugging can occur. High Creek above Richmond also has culverts that can plug.

Irrigation canals are also a flood threat in Cache County. The Mindon Canal is the worst, being high on the side of the hills to the west of Mindon. There is increasing development downhill of that canal. Mindon has been flooded by this canal on several occasions, usually when ice jams block the flow and when the ground is frozen causing increased surface runoff when snow melts.

Roadway failures occur mainly in Mindon and Amalga on Amalga Road by the new bridge. This can also occur on the Clarkston State highway. There is also the possibility of having railroad tracks inundated at Wellsville at the junction of SR 101 and higghway 89-91. Most of the bridges that have experienced damage from previous flooding have been replaced.

There appears to be little threat in the county of losing sewer lines passing beneath rivers, except for River Heights and Providence, where lines pass under the Logan River. Mindon still has septic tanks.

Sedimentation can be a problem in the middle of Cache Valley. Water is held back by Cutler Dam and sediment concentrates there. The effects are in the Bear, Little Bear, and the others; all the rivers meet there near Cutler Dam. Cutler is the main dam in the county.

There are also three main dams up Logan Canyon called First, Second, and Third Dams. The State Dam on the Logan River occurs at the mouth of Logan Canyon at the city limits of Logan. Downstream effects of those dams would all be in Cache County. Porcupine Dam is on the east side of the far south end of the valley. It is privately-owned and is an irrigation dam. Newton Dam is in the center of the valley at the north end near the town of Newton. This is also an irrigation dam, with some recreation use. There is one dam on the Blacksmith Fork; only the dam called the Second Dam exists today and this is used for flood control.

Box Elder County: There is little problem in Box Elder County with debris flows. Brigham Canyon is the only one that generally could have some problem. From Perry to Willard Canyon there could also be some potential. No mitigation is in place for any of these canyons.

The main flood channels in the county are the Bear River, Malad River, Box Elder Creek out of Brigham Canyon, and small tributaries all along the Wasatch Front. Bank sloughing problems occur mainly along the Bear River, but there is little threat to residential areas and the bridges are high enough to pass the trees. Box Elder Creek is also a problem because of bridge clearance. There are many low clearance bridges in Brigham City. In Brigham City, Box Elder Creek passes under a bridge at nearly every north-south street crossing. There may be about 15 of the low-clearance bridges. With channel flows constricted, water can threaten homes upstream of these bridges. This is the greatest residential threat. There are few commercial property areas at risk from such blochages. One problem area could

be the NUCOR Steel plan and one or two other small sites, such as Parsons Construction, but Parsons has enough equipment to take care of themselves.

The Bear and Malad Rivers present more agricultural threat than does Box Elder Creek. Box Elder Creek enters the Bear River close to town, perhaps having one mile from the city limits to the confluence.

The Bear River could flood four city parks. Box Elder Creek has two parks that could flood.

There is a potential for roadway failures from flood. In a highwater situation in Brigham Canyon, SR 89-91 is threatened. If Cutler Dam were to fail then SR 30 and Interstate 15 and SR 13 are at risk and several county roads would also be threatened. The main branch of the Union Pacific Railroad and the Malad Valley spur of the UP could be threatened due to high water on the Bear River or Box Elder Creek, or any of the tributaries south of Brigham City.

There is little danger of losing power poles in a flood, except along the northeast shores of the Great Salt Lake where power poles were lost in 1987, when the lake got close to an elevation of 4,212' msl.

In the scouring of channel beds, there is a potential of losing up to three culinary water lines that pass under, or cross, the Bear and Malad Rivers. Three sewage lagoons, one at Perry, one at Corinne, and one at Bear River, are close to the Great Salt Lake or to the Bear River. Corinne's problem is caused by the Bear River, if it gets out of its banks. Bear River City's is near the Malad River, but it is further away. Brigham City's sewer treatment plant could be threatened by Box Elder Creek. Tremonton's sewage treatment plant is threatened by the Malad River.

Natural gas lines run along the base of the Wasatch Front from the Ogden area. The Facer Mudslide in 1983 threatened this line. A spur line was placed around, crossing the mouth of Box Elder Canyon, then it goes across the mountain range to the north and crosses the Bear River where it goes to serve Tremonton. The Chevron Petroleum Products pipeline crosses the Bear River. The Bear is a slow moving river, even in high water, and it does not erode like a mountain stream. It has many meanders.

In Box Elder County, there are perhaps 50 bridges crossing rivers and canals. Bridge failure, or erosion problems, are always a flood concern. The county has never lost a bridge from flooding, but it could happen. There have never been any lives lost nor injuries due to flooding, or damaging a bridge.

There are a few low water crossings in the county; these are mainly on rural roads. There is one near Lucin with a concrete dip. There is little traffic in this area. There is no history of people being stranded in vehicles.

Sedimentation does not seem to be a problem in the county. The Bear and Malad Rivers move so slowly that they carry little sediment. The flash flood streams are the larger problem coming off the Wasatch Front, such as in the Willard area. Cutler Dam and Reservoir helps to control sediment on the Bear River.

There are two dams that could create a problem: 1) Cutler Dam and 2) the Brigham City Reservoir at Mantua. There are a few irrigation reservoirs out west, but these would produce agriculture-related damages. Utah Power and Light owns Cutler Dam (Cutler Hydroelectric Project). They have prepared an Emergency Action Plan, which is on file with the coounty. This includes an excellent portrayal of the inundati0on zone. If it were to fail, it would flood the periphery of Corinne. It would take 33 hours for the flood waters to reach Corinne, at milepost 31. The dam is 20 miles upstream, not counting the meander distances.

Weber County: There are concerns about debris flow/mudslides from the mouth of Weber Canyon to Riverdale. Mudslides can affect the railroad, some utilities lines, and storm drainage lines. Some development is threatened on the uphill side of the problem areas. The area is unstable for about one mile and there have been several landslides. Landsliding has damaged several homes historically along this one mile stretch in the Weber Delta sediments. A landslide in Uinta derailed a train. The hillside on the north in Uinta is dissected into the old Weber Delta of Lake Bonneville, produced when the Weber River flowed into Lake Bonneville more than 10,000 years ago. This dissection has exposed springs, causing a history of landslides. It is unlikely that the landslides would reach to the Weber River, blocking it.

The 1991 North Ogden Debris Flow caused much IAT work. This debris flow which emanated largely from a rocky watershed above North Ogden following a thunderstorm with a frequency estimated by the National Weather Service as being in excess of 100 years, and by the State Engineer's Office as "going off the charts", destroyed one home, severely damaged two others, and placed water and mud into as many as 400 other homes. This was a major event and it caused the Utah IAT to address the unanswered question of debris flow impact forces and the ability to construct homes to resist those forces. Funding was obtained ($20,000) from the Utah Disaster Relief Board (DRB) and from FEMA to commission a doctoral dissertation with the University of Utah, Department of Civil Engineering, to determine what these impact forces are. For the first time we learned that these forces could possibly be mitigated against on the middle to lower portion of alluvial fans, especially if houses were oriented at an angle to the anticipated forces. The doctoral dissertation, completed in 1997, by Xhilong Deng (study directed by Dr. Evert Lawton; Soil and Rock Mechanics), serves as an excellent foundation to address structural engineering for homes on alluvial fans. A follow-up dissertation is required, enhancing the model. Dr. Deng, as a result of his funding, worked at Utah CEM as an engineering intern for about one year, as he conducted his research. He also addressed several Wasatch Front debris flows, such as the Rudd Canyon event of Davis County (1983) (see Appendix C10).

From the mouth of Weber Canyon westward, there are bridge crossings that have a high potential of damage resulting from erosion to the bridge footings. There are homes in the area which can be at risk because of erosion and subsequence flooding. Mountain fuel gas lines cross the river at about 2000 E. next to Uinta town; at the end of Buena Vista Drive. Farther west, there are sewer line crossings in Riverdale and again in Ogden. Homes in Riverdale are also at risk from erosion and flooding. SR 84 in Ogden received flood damage in both 1983 and 1984 and it is still vulnerable through Uinta and Riverdale. In Ogden, there is flood potential at the Weber County Landfill and the Fort Buena Ventura

State Park. Downstream farther, there are railroad properties and hazardous materials management sites.

From the confluence of the Weber and Ogden Rivers, on out to the Great Salt Lake, there is erosion of agricultural lands and potential flooding of homes in the Warren area. There are tree snags on the bridges associated with high velocities. There is the erosion of the banks and berms that allows flooding of adjacent properties in the Warren area. Mostly here, there is the potential for agricultural losses. There is possible damage to agricultural pump sites (irrigation pumps).

Bank sloughing can be a problem on Wolf Creek above Ogden Valley. There were some temporary changes of the channel in the lower reaches. Headcutting through oxbows changed the channel. The sediment sloughed into the river. There are reports from the Weber Basin Water Conservancy District that the channel is not as deep as it once was. Trees falling into the South Fork of the Ogden River, the Ogden River, and the Weber River were a problem during 1997. The county removed tree jams on both the Ogden and Weber Rivers. A potential problem are for tree jams is on the South Fork River, just above Pineview Reservoir because the channel splits into two channels. The water shallows and trees become stuck in the shallower water.

Sewer and water lines both cross and run parallel to the river. There is the potential for erosion into these utilities. Sewer and water lines pass through Riverdale along the Weber River. Ogden City has lines that cross the river at the Old Coliseum area. There are sewer lines crossing at 1900 West. The county has encased these lines in concrete and protected against headcutting, or the county has gone with overhead and pumped lines.

Problem areas for bridge undermining are at the mouth of Weber Canyon and Interstate 84. Repairs and mitigation measures taken were installing pilings downstream to prevent headcutting. Other locations downstream require continual maintenance to remove snags under bridges. The bridges seem to be high enough. The center support catches debris. No lives have been lost, nor have there been injuries due to bridge problems in floods.

There have been some road inundations from flooding. These resulted in a failure of the road surface. At one location, the county did have the potential of isolating businesses on 1990 West and about 1300 South near SR89. Roads were inundated out west in the Warren area. One road was closed because it washed out. The road was cut with a backhoe to relieve flooding. The water was going over it. The flooding damaged the road surface (asphalt and base). This did not isolate anyone and posed no threat to people.

There are petroleum pipelines crossing the Weber River near 1700 South and 1200 West. These cross beneath the river. There was no problem with them in 1983, nor 1986. The county never heard of any problems with them.

Davis County: The relationship between damaged watersheds (such as from wildfire) and debris flow is well-known in Davis County. The Natural Resources Conservation Service (Bob Rasely, Geologist)

conducted a study of many Wasatch Front Canyons to estimate the amount of sheet erosion thgat could result from burned watersheds with thunderstorm activity. It was proposed that the Davis County Commission be approached by several interested parties(fire workers, the Utah Interagency Technical Team, Davis County Public Works, etc) to restrict fireworks on the watershed within one mile of any development. The county would be asked to pass an ordinance and work with the U.S. Forest Service to develop and enforce this. The USFS already has a requirement that fire permits be obtained for any campfires during high-hazard fire days. This could be enhanced to require it for any campfires at any time, so that watersheds will be protected from wildfire. A reason for this is that there are still five canyons with no protection (debris basins) from debris flows (see below). At the least, the complete restriction on fireworks and campfires should apply to these five canyons. This kind of mitigation has zero cost involved, but has great potential for lessening the threat from debris flows. Regarding the five canyons noted, there is no guarantee that all debris basins will work as intended - there are many unknowns. The alluvial fans with "entire fan" mitigation should also be considered potential dangerous locations because of the potential for debris flows that may exceed the capacities of the debris basins.

The Idaho experience with the Lower Banks Debris Flow illustrates the ramifications of burn areas followed by debris flows. FEMA implemented "imminent threat" to relocated people from the alluvial fan, because of the increased threat from the damaged watershed. "Imminent Threat" lasts for five years, from the time of FEMA implementation, according to the FEMA definition. These are long-term consequences to burn areas followed by debris flows.

Environmental groups have opposed reseeding of burn areas, indicating that they want a natural approach. The problem with this is that natural reseeding introduces types of weeds that are not best for soil protection. There is a need for an Interagency Technical Team (IAT) presentation on this issue, made to local government and environmental groups.

Pipeline companies damage watersheds in placing pipelines in the ground. Interaction should be made with these companies to determine what steps they will take to reestablish the vegetation to minimize erosions problems. An example was the placement of the Kern River Pipeline, which Davis County Public Works and Flood Control feels left potential erosion problems. Another pipeline is entering the south end of the county, from Kimball Junction to North Salt Lake - this may enter Davis County. There should be coordinated county/IAT contact made with this pipeline company.

Corporate Hazard Mitigation Funding Issue: There are potentially dangerous locations in the state, especially on unprotected alluvial fans. There is rarely funding for hazard mitigation to protect these locations. Colorado created their Natural Hazards Foundation obtaining funding from corporations. Their incentive is public relations and there are tax incentives. Davis County is interested in pursuing this approach for Centerville Canyon's alluvial fan and needed bedris basin. The county-area fire workers, and the IAT will work toward locating funding for projects, such as the Centerville Canyon debris basin. Centerville was selected as Utah's first Project Impact community, and as such, has received much pre-disaster hazard mitigation funds for both Barnard Creek and Centerville Canyon. Thus, progress is being made.

Activating SNOTEL Sites to Report Precipitation Rates: The NRCS Snow Survey Office can activate SNOTEL sites to transmit precipitation figures each 15-minutes, as needed when there is concern about flood potential. Davis County indicated that this would be an excellent service and that there would be times when this could be required. During such times, when flash flooding or debris flows could be required. During such times, when flash flooding or debris flows could result, NRCS/Snow Survey should monitor rainfall at the SNOTEL sites.

Debris Flows: Debris flows resulting from ground saturation and runoff are an ongoing problem in Davis County. The county shares the flood potential of the Weber River, as the middle of that river forms the boundary with adjacent Weber County. Thus, the reader can review the flood potential described above for Weber County. Otherwise, Davis County is characterized by mountain streams that rather quickly transect the valley to the Great Salt Lake. The many alluvial fans at the mouths of the canyons are largely developed and vulnerable to debris flows and flash floods. Some have entire fan mitigation, in the form of debris and detention basins. There are 15 main canyons, ten of which have structural mitigation in place.

Protected Canyons:

Mill Creek - 2 debris basins
Barton Creek - debris basin
Stone Creek - debris basin
Parish Creek - debris basin
Ricks Creek - debris basin
Steed Creek - debris basin
Farmington Creek - debris basin
Shepherd Creek - debris basin
Baer Canyon - debris basin
South Fork of Holmes Creek - debris basin\

Unprotected Canyons:

Deuel Creek
Barnard Creek
Davis Creek
Snow Canyon
North, South, and Middle Forks of Kays Creeks

Bank sloughing hazards are not a major concern in Davis County. There are not many houses that would fall into creeks from bank sloughing. The real threat from bank sloughing is from sedimentation downstream. There are a few houses along the channels that have a direct threat to bank sloughing. Trees and debris falling into channels can pose a significant threat, as a general condition, along the Davis County Wasatch Front. This can cause channel flow constrictions and water leaving the channel. The streams in Davis

County all begin in canyons and pass across alluvial fans, then across the eastern side of the valley and passing into the Great Salt Lake. Water that leaves the channels on alluvial fans may not get back into the channel and flood homes. With river flooding, the water will eventually get back into the channels. All alluvial fans are fairly-well developed. The North Fork of Kays Creek is not presently well-developed, but soon will be. Occasionally, commercial property is only located lower on the alluvial fans, but generally not. During the last flood in Bountiful, the trees, etc. that had fallen in, plugged the grates on Stone Creek and flooded the mortuary. The flooding of agricultural lands is more on the lower ends of the channels, being more of a delta problem. There are not many agricultural areas high on the fans. There were orchard areas, but these are largely gone now. Channel change has not been a major problem from any type of flooding. The channels have remained where they were before. There are no ox-bows in Davis County.

Conduits being plugged by channel debris is an ongoing problem. There are a few thousand culverts in the county. The debris in the flows can always plug a culvert. Culverts are designed to cover the 100pyear event with a substantial safety factor (now construction). Any culvert can be plugged with debris, however. On an average main stream there may be as many as 15-20 culverts between the canyon mouth and the delta. There are a few high road fills in the county, such as on Mill Creek in Bountiful; Davis Boulevard; Kays Creek at Gordon Avenue; and the South Fork of Holmes Creek and Fairfield Road. These are the main high road fill sites that could be breached and cause a problem during flood events, if the conduits were plugged by debris.

High flows and increased velocity can affect recreational features in Davis County. Lagoon, on Farmington Creek, is the main concern. Layton Commons Park in Layton is on Kays Creek; there is a city library and City Hall that could be at risk. The Ricks Creek Park in Centerville on Ricks Creek could be of concern. There is a park on Steed Creek, but it is a multi-use flood control structure. The Jemmy P. Stewart Elementary School grounds is also a flood control/detention basin.

Overbank flooding threatens many businesses in many areas of the county. There is no large economic effect. The flood impact area is usually rather limited. Flood insurance is also available to anyone wishing to purchase it. The failure of the foundations of businesses and homes is an isolated problem. There is one home on North Canyon and one or two in Centerville and one on Steed Creek that could be of concern. There are three or four in East Layton on Kays Creek. The one in Centerville was built about 1980. The creek goes by its foundation near 4th West. The deck goes over the creek.

There appear to be only a few serious concerns with the potential for undermining roads. There is one location on the North Fork of Holmes Creek in Layton. The entire Centerville area has potential for roads being undermined. The 500 West road off Ramo in West Bountiful is of concern. Railroad inundation is a potential problem on Barton Creek in West Bountiful, where it crosses the Union Pacific railroad grade. This may be the only location of special concern. This area floods whenever there is a major storm on that channel.

Utilities are also at risk from flooding. There have been examples of debris flows damaging power substations, such as on Stone Creek in 1983. Other than debris flows, lightning is a concern. Most new subdivisions are putting in underground utilities and this may enhance flood damage and problems during

future floods, causing power outages. Electrocutions from flood damage to power lines has not occurred in the county. The natural gas supply system appears to be quite safe from flooding. The telephone company protects its connectors well. There has been backup of sewers into homes. These problems are not recent. Sediment washed into sanitary sewer systems has occurred, plugging the homes. Then homes above the plug get water into their basements.

The scouring of channel beds is an isolated problem. It does cause the additional problem of sediment plugging downstream channels. The Weber Basin Aqueduct line was exposed and broken when the Rudd Creek Debris Flow happened in 1983. This was an 8' diameter water line. The debris flow scoured it out. This affected the water supply to Bountiful. The southern end of the county pulls its water from the water treatment plant at 400 North and Davis Boulevard, which is fed by the aqueduct. The Weber Basin aqueduct is at risk at all canyon mouths in Davis County. For example, at Farmington Canyon, the aqueduct passes just east of the Farmington Pond Park. There are many distribution lines, but these are generally considered to be at low risk. There are several locations where sewer lines cross channels. If we get erosion at those locations then we have the risk of losing them. All new crossings were required to be protected against erosion. Farmington Creek, just west of the Union Pacific Railroad is of concern. At the North Fork of Holmes Creek, in the East Layton area, the sewer line runs along-side of the creek. Water quality has not yet been impaired. There are only a few places where Davis County is using streams or springs for water supply. One is Mill Creek in Bountiful. This would require a debris flow to damage it. There is a small treatment plant along-side the channel. This could affect water quality. In 1983, the Rudd Creek Debris Flow damaged the spring collection system for Farmington, and this put them on the contaminated water supply list. Fruit Heights uses a spring for a water source. If a sewer line broke during a flood, there coould be contamination, but this is not considered to be a serious possibility, nor threat. Even if contamination did occur, there is not much environmental damage anticipated. Streams flush themselves out quickly in flash floods/ The problems with wetlands is not well understood. Each channel has wetlands, especially in the lower reaches, near the deltas.

Natural gas line rupture is a major concern in debris flows. There are no particular places of conern. We not only have the gas lines, but also the petroleum product lines. The Kern River pipeline crosses Mill Creek and misses Barton Creek. It also crosses North Canyon and the Jordan River. The Rudd Canyon debris flow damaged the gas lines, threatening the nearby homes. Some lines into the area were shut down until repaired. There have never been fires or explosions from debris flow or flood damage to pipelines, but the potential is there. There is a limited threat of electrocution from flooded basements. In 1983-84, there was a person killed in Salt Lake from electrocution from a live wire.

Concern about bridge failure is relatively minor. Davis Boulevard and Barton Creek has limited risk. The bridges in Farmington Canyon are of some concern. On Kays Creek in West Layton, the Denver and Rio Grande Railroad has a bridge that could be of concern. Most of these bridges were built before the concerns about 100-year floods became an issue.

In Davis County there are several irrigation dams and reservoirs, such as Hobbs, Adams, and Farmington Pond. There is another one in Layton on Church Street and Fairfield Road. In Kaysville, there is one on the South Fork of Holmes Creek at Hodd's Hollow. There are irrigation reservoirs at the North Fork of

Holmes Creek, east of SR89, and one at the mouth of Baer's Canyon, and one on each side of Farmington Canyon, at the mouth; and one in Centerville, and one on Davis Boulevard just south of Mill Creek. There is one on Davis Creek, at the mouth of the canyon, that is threatened by debris flows and overbank flooding of the stream. Some of these ponds, were they to breach, would threaten developed areas. Still, it is unlikely that the ponds would breach and there is no history of this having occurred.

Morgan County: There is little problem in Morgan County from ground saturation and debris flows. One or two minor mudslides occurred when a farmer's water line broke. Landslides are a problem. Volcanic material in Mountain Green is unstable; some problems occur when building there They hit shale at about 8 - 9 feet; also volcanic ash which is expandable and collapsable soil; adds to potential for drainage problems. The developers add drains to drain the soil. There are geotechnical reports that define how to mitigate as lots are sold; unless the reports indicate that the ground is too unstable. The county estimates 75-100 homes, including those in Highland Cove. Another subdivision is planned for this year, maybe adding another 20 homes.

Regarding bank sloughing. Generally, the banks along the Weber River in Morgan County do not experience significant problem with bank sloughing. This is likely the result of a considerable amount of river bank vegetation along the Weber River in Morgan County. East Canyon Creek is the worst. There is some bank sloughing on Strawberry Creek, in Mountain Green, where some building is going on. The creek comes down from Mt. Ogden.Trees and debris can fall into channels, producing log jams on both East Canyon Creek and the Weber River; some jams were removed. This is characterized as a moderate problem. Channel flow constrictions have not been a significant problem, but it could be. There are many trees by the creek and river.

Lost Creek has bridges that plug with debris, including the bridge at the cement plant. Some water has gotten out of channel, as a result. The county had 25 pumps removing the water in 1983. There is a perched channel on Gordon Creek. The river bottom is higher than the surrounding ground. This may cause surface scouring, but the problem is mainly a surface flooding problem.

The Weber River channel bed in the main part of the river valley is primarily an area of deposition, rather than erosion. During the 1983 high-river flows, there was some erosion and one sewer line was excavated. In the narrow canyons, the river channel is too rocky, containing large boulders, to generally be vulnerable to much erosion.

Two culinary water lines cross the Weber River at Morgan. The erosion did not reach these lines in 1983. One line crosses on the west side of the State Street Bridge. Another line crosses under the river by the upper railroad underpass, and the line crosses near that underpass.

The city's sewer line crosses the river at about one mile northwest of the State Street Bridge. During spring flooding in 1983 the erosion removed the gravel/eroded the river bottom and got to the sewer line and took it out. The line is now encased in concrete, so this should not happen again. Scouring went down about 30 inches. this has lowered the river level, and the level is still low today. There is a three-foot encasement of

cement, or 18 inches on a side. Another sewer line crosses the Weber by Bill Colvell's House about 1/2 mile west of the State Street Bridge. That one is encased in concrete also. It was not excavated during the 1983 flooding.

For the county there is no sewer; except there must be some sewer lines crossing Gordon Creek in the Highlands area. They must be 10' below the creek bottom. This should keep them safe from river bottom scouring. This is a community sewer system. One crosses Dry Creek on Trappers Loop Road.

Mountain Fuel (now Questar) has some natural gas lines crossing. They may all be suspended on the bridges. The lines are suspended on the Morgan City's east bridge, but may also be on the west bridge, as well. An 8" high pressure line goes over Trappers Loop. This is buried. There are no apparent problems, unless someone uses heavy equipment to excavate in a creek or river bottom. All in the county are buried.There are no buried lines crossing the river.The telephone lines are all above water, crossing at the bridges or are in the air.The Pioneer and Amoco Pipelines cross the Weber River once about 1/8 mile above the Fairgrounds. These lines were not excavated during the 1983 floods. These lines also cross by Croyden (more than one crossing of Weber River and Lost Creek). Lines cross at Peterson too. Questar and Pioneer Pilelines are close together. They are likely encased in concrete, at least to hold them down.

The Como Bridge caused concern in 1983, but it survived. In a flood larger than the 1983 floods, if debris were to block the flow under the bridge, there could be problems. There was more water in the river in 1984 than in 1983. One concern might be the age of the bridges. They are getting older. Possibly they may need some maintenance, or redecking in the future. They did hold up well in 1983 and 1984. There was not much worry about losing them during those flood years. During the floods of 1952 the water came close to overtopping and maybe losing the bridge. In 1952, there was a D8 Cat tied to the Como Bridge to hold it in place. The 1952 flood was greater than a 100-year flood, reaching 7,400 cfs; the 100-year flood is about 6,400 cfs. The state does a survey of the bridges each two years. No bridges have failed; there have been some standard repairs. In 1952, the Stoddard Bridge was lost.

In 1997, the county was close to experiencing overbank flooding on the Weber River. East Canyon (Hardsgrabble snowmelt came down slow) and Lost Creek remained within its banks. Deep Creek went over its banks in January when it warmed for a few days. In a 50 or 100-year flood, then there would be considerable overbank flooding. The Island Road area on East Canyon Creek has an estimated 30 homes at risk. There is also a low area in the Richfield area where we are just building some 13 lots and issuing permits now. Within a few years, Morgan may have 13 homes in floodprone homes there. There are a few homes at the bottom of the Highlands. At the Highlands there is a commercial horse facility. On Cottonwood Creek there is a shrimping business. They are not shown as being in a floodplain. There is an area at Mountain Green, between I-84 and the old highway that will get an interchange; it has commercial zoning; maybe a bank.

The Morgan High, Junior High, and Elementary Schools appears to be within the floodplain. Cemeteries are all on high ground. There is an ancient Indian Cemetery next to Como Springs in a low lying area.
The flooding of agricultural land is a main concern because there is so much farm land. This is not belt flooding, but more in pockets. Crops are mainly alfalfa and grains (feed crops) and there is pasture. Loss

of Top Soil Due to Erosion has not been much of a problem in the past.

There are no known stored hazardous materials, except for pesticides and fertilizers.

Road Inundation may occur only in the event of a large flood; Croyden Road could be lost (could go around back way). Floodplain maps show the 100-year floodplain remaining below the road. Flooding at Richfield Lane (in county outside of Morgan, 3 miles to south of Morgan) could cover the bridge. The Fairgrounds area and Como Springs would be inundated.

Sewer line damaged is not a concern as the majority of the county is with septic systems. The low lying areas described above (residential flooding) often have septic systems; flooding of these would create loss of the systems. Of the newer homes, there are maybe 25 vulnerable to flooding; could be 50 total of older and newer homes - county-wide. Low-lying areas in Peterson could add another 20 or 30 homes. In all, county-wide there could be 70 homes with septic systems.

Salt Lake County: There is not a current flood hazard analysis for Salt Lake County. Salt Lake City is the current Utah Project Impact community and analyses are being worked on and will be added to this State Hazard Mitigation Plan when completed. There is much information on Salt Lake County flood vulnerability contained in the 1983, 1984, and 1986 Utah Hazard Mitigation Plans; however, much mitigation has been developed since the 1980s.

Summit County: There is not a current Summit County flood hazard and risk analysis. A wildfire hazard mitigation plan was prepared for the county by the State Hazard Mitigation Officer in 1994. This effort also included the piloting of the Urwin and Wufi Children's Adventure with Wildfire, where the program was introduced at the Jeremy Ranch Elementary School and at the Kamas Elementary School. A monsoonal flood in the summer of 1998 caused the activation of the Utah CEM Response Team, but not the Interagency Technical Team and no mitigation planning was conducted. The latest information of flood risk for the county is contained in the 1983 and 1984 Utah Hazard Mitigation Plans.

Wasatch County: There is not a current Wasatch County flood hazard and risk analysis. There are Utah Interagency Technical Team ONSITE Reports for Wasatch County addressing flood and landslide events (see Appendix A1 for details). The Urwin and Wufi Children's Adventure with Wildfire Program was piloted in Wasatch County in 1994 in Coalville. Wasatch County has expressed an interest in Project Impact. The Utah Interagency Technical Team (IAT) has worked with Wasatch County in 1999 due to extensive landslide complexes identified by the Utah Geological Survey in the Timber Lakes area and also in several mountain communities on the west side of Heber Valley. In one such area of Timber Lakes, more than 200 homes are in a Landslide Study Area of the UGS. Thus, the UGS has completed, and is still conducting, Landslide Hazard and Risk Analyses for Timber Lakes and other communities. These reports can be obtained from the UGS but are not included in this present Utah Hazard Mitigation Plan which is focusing for the moment on flood and drought hazards, but including other hazards as they may relate to flooding. There is one stream in Wasatch County that does threaten to block a stream and that is on Snake Creek on the west side of Heber Valley. The Utah IAT has addressed this slide, as is the UGS, but the

threat of stream blockage does not appear to be substantial yet. This landslide complex is an ancient one with periodic isolated movements. In 1990, a major wildfire occurred in the Wasatch Mountain State Park area and a mitigation plan, and the first State Wildfire Hazard Mitigation Plan was prepared (for details, see Appendix C9 and A5, respectively). Following this wildfire, precautions were taken in Midway for flash flooding and the NRCS Emergency Watershed Protection Program (EWP) was implemented with emergency flash flood mitigation measures. A Master's Thesis was undertaken by the University of Utah, Department of Geography on the Vegetation Recovery and Dynamics Following the Wasatch Mountain Fire (1990), Midway, Utah, (1992). This document is identified in this Plan as Appendix C3. This thesis resulted from IAT work on the wildfire.

Duchesne County: Over the past decade, the Utah Interagency Technical Team (IAT) has responded on one occasion to flood potential in Duchesne County. In June of 1995, the city of Duchesne was threatened by snowmelt flooding on the Duchesne River. The flood scenario involved an above average snowpack with a condensing snowmelt window. The Duchesne River had been out of its banks with no serious flooding, but the river was flowing at about bankful and the Upper Stillwater Reservoir was anticipate to fill and spill, increasing the flows down Rock Creek into the Duchesne River with the potential for flooding. The Duchesne River drainage had about 1,214 percent of normal snowwater and 145 percent of normal precipitation. To exacerbate the problem, it was discovered by the IAT that the Duchesne River had, before 1900, flowed through the middle of Duchesne, but had been channelized around a sharp bend and then along the north side of the city. The old channel still existed in the topography, which was separated from the new channel, at the sharp bend, by just a relatively narrow berm. If that berm were to breach, the floodflows could again pass through a city now developed in the path of the flows. At the request of the IAT, the County declared an emergency, and the IAT requested that the Natural Resources Conservation Service (NRCS) implement its Emergency Watershed Program (EWP), which it did. Within about three days, NRCS had approved more than $100,000 to riprap the bend in the river and to armor another stretch of the river near new homes in Duchesne.

The Utah IAT reported on Monday, June 18, 1995, that " The snowmelt from the high Uintas, above 10,000', is just beginning. There is much land area at and above this elevation. At present, the snowmelt rate at these higher elevations is between 0 - 1.0 inches per day, a low amount, and flooding is just beginning. Flooding is expected from the snowmelt, but mainly not until next week. Moderate temperatures this week will keep the melt rate low. There needs to be warming with south winds to accelerate the rate. The snowmelt window is greatly decreasing with this slow melt. The present flooding is a preview of what is to come. The runoff at that point (in one week) will be high and of long duration. Normally, we would have seen these peak flows one month ago.

The Utah IAT then reported on June 13, 1995, that "The Uinta Mountains started their snowmelt today. Thee are between 20-30 inches of water in the snow between the elevation of 10,000 and 13,500'... At these upper elevations, the percentages are far above average with two sites having snow water equivalent percentages in the 1,700 to 1,900 percent range.

Although Duchesne County and its main cities/towns do participate in the NFIP, still there is not much

known about the flood potential here. There seem to be few examples of flooding that materializes off the south side of the Uintas. From year to year, the various rivers/streams seem to handle the flood flows off the Uintas remarkably well, with few concerns. Still, in 1983, Duchesne County was included in the Presidential Disaster Declaration, but not in 1984. The State Hazard Mitigation Plan for 1983 makes brief mention of that flooding, stating that "Duchesne County suffered flooding damage similar to neighboring Uintah County. Flood waters and debris from the Yellowstone River, Strawberry River, Duchesne River, and Red Creek flooded over their banks damaging roadways and the river embankments. The debris level was high along the river causing blockages in the culverts and at bridges, and multiplying the flooding problems along the rivers and creeks. The main recovery activities in this area involved embanknent, bridge, and culvert restoration as well as some preventive dredging."

These descriptions give a few of the main views that we have obtained on Duchesne County flood threat.

Uintah County: The Utah Interagency Technical team (IAT) has responded on two occasions to flood threat in Uintah County, especially to Vernal and Ashley Creek. The first response was in June 1995, simultaneous with the Duchesne County flood response described above. Still, the mitigation along Ashley Creek (levees and set-backs) prevented most major damage, other than minor bridge and road damage and some excavation of concrete-encased sewer lines. These levees were formed from river gravels that had choked the channel following floods. The gravel was pushed from the stream bed against the bank to keep the channel clear and to fortify the bank. This measure did help on the short-term by maintaining capacity, but the gravel banks easily eroded-transferring the problem downstream. In 1995, the potential existed for greater snowmelt flooding, but the weather "cooperated" and brought the snowpack down gracefully. The second IAT response was on May 19, 1997, when the Dry Fork Erosional Chasms caused natural damming of Dry Fork which sent surges down Dry Fork into Ashley Creek, flushing silt into farm fields and irrigation diversions and canals. Once the reports of red muddy water in Ashley Creek were known, the IAT flew into the area to determine the source and cause. The erosional chasms were quickly-spotted and reported from the aircraft as a major and hazardous feature. The feature continues to be poorly-understood and a threat to Vernal. Fortunately, it has not activated to any major degree. As a result of this flooding situation, the Natural Resources Conservation Service got involved and took an approach to provide more durable revetments. After conducting field surveys of the identified reaches, it was determined that repairs would basically fall into the categories of debris removal, bank stabilization, and channel dredging. Debris removal consisted of removing large trees that had fallen into the creek. In many locations, log jams had backed up the water which in turn traveled over the flood plain removing topsoil and cutting side channels. Considering the degree of damage caused by the log jams, debris removal was a significant preventative measure looking ahead to the next year's spring runoff. Considering the vast amount of sediment load which entered Dry Fork and Ashley Creek from the upstream erosional chasms, it is doubtful that channel excavation will provide anything more than a temporary fix because a large volume of sediment remains in the channel upstream of the excavated sites. Rootwads were used to stabilize the eroded banks in lieu of riprap because rock native to the area was mainly sandstone, which was unacceptable as a riprap material. A few years ago, barbs were constructed of limestone which appeared hard during installation but quickly deteriorated. The rootwad revetment was a combination of logs and trees pinned together in a criss-cross fashion. The root ends, oriented upstream, acted as deflectors and slowed the water flowing against them. The rootwads were overlaid with gabion mattresses, rock backfill,

and soil. Live willow clumps were also placed between the rootwads to create a more natural appearance.

The Utah IAT ONSITE Report stated the following about the Dry Fork Erosional Chasms on May 19, 1997:

> "Uintah County reported that Ashley Creek was flowing with a deep reddish color on Monday morning, May, 19, 1997. Utah CEM organized a flight to identify the source of the coloration. Fred May, IAT Coordinator, and Jeff Bench, Uintah County Liaison, flew with Mike Royce, UHP Aerobureau, in a fixed-wing aircraft to locate the source. The source was identified as a massive debris flood that scoured into a mountain side above Dry Fork in Uintah County. The feature measured about one-half mile long, 300-400 feet wide, and about 200 feet deep. An estimated 1 to 2 million cubic yards of sediment eroded, forming a massive alluvial fan at the bottom of the canyon in Dry Fork. Fred May shot aerial video of the scoured canyon, the resulting alluvial fan, and the debris-laden flood zone down Dry Fork and into Ashley Creek and through Vernal. This was reported back to Utah CEM and to the Utah Geological Survey from the aircraft at approximately 1:00 p.m. The group then landed in Vernal to meet with the Uintah County Emergency Management Director, Dale Peterson. Dale Peterson requested IAT assistance in evaluating the hazard, conducting an initial risk assessment, and making mitigation recommendations. Dale Peterson had returned from a ground visit to the area above the chasms."

Based on mitigation efforts of the NRCS, it is thought that Ashley Creek may be relatively disaster-resistant. Still, the unknown is the potential for the Dry Fork Erosional Chasms to activate with considerable more erosion and to choke Dry For again with the potential for large surges of debris-laden water downstream.

Uintah County Flood Hazard Risk Analysis:

The following hazard and risk analysis was conducted in Uintah County by the Utah IAT after the Dry Fork event. The wording in the text is taken from the interview process and is a first draft.

As a result of ground saturation, debris flow triggering mechanisms within the county include: 1) spring water "blow-outs" caused by charged ground water during periods of high snowmelt and thunderstorm activity, 2) slumps/landslides, 3) damaged watersheds (e.g, burn areas) with thunderstorm or snowmelt runoff accompanied by sheet erosion.

The Dry Fork features (Erosional Chasms) were not due to ground saturation problems. When the surface layer above the chasms was gone due to scouring from the flood caused by the breach of the Mosby Canal (a canal that provides irrigation water off the south flank of the Uinta Mountains above Vernal). The winter of 1997 was a heavy snow year and ground saturation may have contributed to the erosion. A combination of components resulted in the event. Seepage in the walls of the chasms likely contributed. In the Dry Fork area only dirt roads are threatened. There is actually not much at risk, except downstream. Ashley Creek Gorge is of hard rock. There are numerous ancient landslides in the Dry Fork area. Farther west, the White Rocks area had a debris flow associated with a wildfire burn in the 1980s. In late 1960s, a small

earthquake triggered a slide in Dry Fork. A landslide above the "Lower Sink" has the toe cut and a scarp has been produced. This will require observation.

Dry Fork has had high-flow problems each few years (1993 and 95); maybe a ten-year flood. The peak was due to a thunderstorm event. The channel now is agraded so much that it cannot handle much of an event. The channel experienced one main surge event on Monday morning or by noon. From McConkie Bridge downstream, the "Cats" re-established the channel. The county does not know how much the channel has changed. The upper part of the river filled in 6'-deep, then ran out through the trees.

A large problem now is the lower mile of Ashley Creek where it is plugged off to below Massey Bridge. This area runs through meadows into Stuart Lake. Here, homes and bridges are at risk because there is no place for the water to go. The flow moves large boulders. The main hazard are rocks moving back and forth in the flow.

The silting of irrigation canals caused their complete failure

The increase of velocity caused the entrainment of much more sediment along Dry Fork. This was a problem because when the flow slowed with a lower gradient, it dropped much sediment, filling in the channel, diversions, and irrigation canals.

High velocities are a problem on the Green River for recreation. This undermines boat ramps; a child was sucked out of float tube. All bridges are in danger from high and fast flows. Brush Creek is susceptible to high and fast flows when the valve on Red Fleet Reservoir is opened.

Bank sloughing is a problem on Brush Creek and all along the south flank of the Uintas. There is also a problem in the Book Cliffs but not many people live there. Evacuation Creek produced fatalities when it reached about 300-400 cfs; a car washed away, below White River. Also on Dry Fork there are bank sloughing problems, but not as bad as on Ashley Creek. Pretty armored. Ashley and Brush ck are more of problems.

Trees and debris fall into the channel is a county-wide on the south slope. There are now hundreds of trees in Dry Fork producing debris jams that work together with the rock bars.r. Most trees and boulders did not make it downstream. There are also more cotton wood trees down this year, than before.

Channel flow is constricted by Raspberry Patch; very constricted. High channel moves back and forth and is reestablishing within the flood plain. More water is out of bank this year than any other year, but still remains within the floodplain, but out of the channel.

The Dry Fork Chasms flood(s) threatened some homes near the mouth of the Canyon near the confluence with Ashley Creek and downstream. A helicopter survey identified approximately 80 homes on flat floodplain areas that seemingly could be reached by high surges. These would be at minor risk. Another 30-50, including condominiums, could be at higher risk. None were, in fact, reached during this flood. One home at 1500 North and 2500 West had water out of banks and across a road.

Commercial property at risk includes the Coca Cola Plant and the Health Club on 1200 North and Ashley Creek in North Vernal. There is also a camp ground at risk. Dinoland Golf Course on Ashley Creek is also at risk.

There is not much threat to agricultural land toward the mouth of the canyon. The biggest risk is losing the diversion dam so that irrigation water cannot enter the canals. There are two other larger diversions. These are the Highline and Thornberg diversions. Irrigation is for mainly alfalfa and hay. On the Lower Ashley Creek there is also some corn and grains. Bennion Pond, near the mouth of the canyon on Dry Fork lost fences and was threatened by scouring.

The Ashley Creek flows into the Green River. Here, the Green River provides irrigation water to alfalfa, corn, small grains, and grass pastures.

No industrial areas are threatened by flooding by Ashley Creek, nor Dry Fork.

The plugging of culverts on Dry Fork at McConkie Ranch Road (1500 South) are removed each spring.

The flood threat on Ashley Creek includes about nine bridges. These are located on Ashley Creek at:

1) McConkie Bridge (County Bridge)
2) 1500 W (County Bridge)
3) 2500 W (County Bridge)
4) 500W (County Bridge)
5) Vernal Ave State (County Bridge)
6) 500 E (County Bridge)
7) 5th n at 1600 E by old city dump. (County Bridge)
8) Sadler Bridge (County Bridge). Now broken and undermined on one end.
9) Below sewer lagoons (culvert)

Generally these bridges survive floods with minor, if any, problems.

No railroad are at risk.

Power poles overturning are rarely a problem. In 1995 only one pole had a problem. Otherwise no problems.

Power outages from flooding are no real concern.

Water lines pass under some channels or canals. The Feeder Canal to Steinaker Reservoir goes underneath. The 1500 West Siphon goes under Ashley Gorge; the water lines cross Ashley Creek several times or adjacent to stream. Merkley Park did rip rap to protect water lines.

Sewer line damages are a possibility from flooding. The Vernal Avenue bridge has a sewer line encased

in concrete. There is a main sewer line at every Ashley Creek bridge crossing; such as at 1500 West and 2500 West.

Rupture gas mains are not too likely. The lines ate hooked to the bottom of bridges at 1500 West, 2500 West, 500 West, Hwy 191, 500 East, and 1500 East. There is a high-pressure gas transmission line (10" Mid-American Pipeline) at Jensen. A Chevron products line from Evanston crosses by Brush Creek. Gas lines cross in many locations.

The isolation of people, or traffic disruptions, caused by flood damage to bridges is a possibility. A main location would be the McConkie Bridge on Ashley Creek. This could also cut off emergency services to the 50+ residents living on the east side of Ashley Creek. The Bonanza and Ouray Bridge across the Green River could cut off all access to the southern part of county, and also cut off all access to oil and gas wells and to the Bonanza Power Plant..

Daggett County: Daggett County was included in the 1983 Presidential Disaster Declaration, but since that time the Utah Interagency Technical Team has not been called to assist with any kind of emergency there. The 1983 State Hazard Mitigation Plan indicates that Daggett County was "the least severely-damaged of all counties. Daggett County sustained damage from flooding along Birch, Red, Grouse, and Pat Creeks. Embankments, culverts, and roads were damaged. A 272-foot, one-lane bridge over the Green River was destroyed. Replacement of this bridge is being funded from several Federal and State funds due to the low annual budget of Daggett County. The relatively minor damages are in part explained by the remoteness of the area and the county's sparse population. Recovery. Recovery activities were justifiably limited. In 1998, Long Park Dam and Reservoir came under the concern of the Natural Resources Conservation Service (NRCS). Sink holes formed beneath the dam in limestone bedrock. These also involved the dam creating a dam failure hazard. An $8 million mitigation package is being developed under the auspices of Senator Robert Bennett. This should more than adequately protect this structure from failing. The reservoir has been empty for more than 1.5 years, and will remain drained until repaired. Prior to the floods of 1983, flash floods occurred on Sheep Creek that killed campers. To this day, the U.S. Forest Service, who overseas this area of the county, evacuates campgrounds on Chicken Creek as thunderstorms approach. The main threat to the county actually seems to be wildfire due to abundant beetle-kill in the forests. Still, the State is not involved in much wildfire response to the area.

Utah County: A detailed hazard and risk analysis has not been worked up for Utah County. The Utah Interagency Technical Team (IAT) has only responded to flood threats of relatively small potential impact. In 1997 and 98, the Utah IAT responded to requests for assistance for the Schurtz Lake Landslide in Spanish Fork Canyon on the south side of SR 9-50. The landslide, about 1/5 the size of the Thistle Landslide, about two miles farther upstream, held some potential for blocking the Spanish Fork River, just above the confluence with Diamond Fork. An evaluation by engineering geologists and engineers from the Utah Geological Survey, U.S. Bureau of Reclamation, and Utah Valley State College, suggested however, that the slide could most likely not block the river because of the broad nature of the floodplain; the river could easily go around the landslide. A survey of debris and detention basins by the State Hazard Mitigation Officer, and County Officials, and the U.S. Army Corps of Engineers showed that the county's canyons were generally well-mitigated and that flood threat since the 1980s had been greatly mitigated.

One area of vulnerability still seemed to be through American Fork and Lehi where channels come quite close to homes and businesses. Still, there is much upstream structural control.

Tooele, Juab, and Millard Counties: The Utah Interagency Technical Team (IAT) has had no requests to provide assistance to Tooele, Juab, and Millard Counties, likely due to somewhat less flood threat than is found in counties to the east of them. Tooele County has experienced deep snowpacks in the past few years with the threat of flooding that fortunately did not materialize. It is possible for flooding to strike Tooele, but there is not much history of this. As with most of Utah, Tooele County was included in the Presidential Disaster Declarations of 1983 and 1984 as a result of flood damage. Flooding in the city of Tooele are due prinarily to four stream sources: 1) Settlement Canyon, 2) Middle Canyon, 3) Unnamed Canyon, and 4) Unnamed Canyon No. 2. These streams originate in the Oquirrh Mountains immediately southeast of Tooele and they flow, in general, in a northwesterly direction. The natural flood hazards are the typical shallow channels found on alluvial fans and slopes sufficiently steep to cause eroding velocities to occur. Thus, floodflows tend to overtaop the main channel banks and develop new channels. These flood hazards are more prevalent in Settlement Canyon within the city than in other drainage areas. Historically, maximum floods of record have occurred during the April through June snowmelt period and have resulted in prolonged periods of high flows varying from a few days to several weeks. Cloudburst typs floods and floods resulting from combined general rain storms and melting snow are also common. The three maximum floods of record (1960-74) on Settlement Canyon at the discontinued crest-stage partial record station (No. 1017290) located about 3.5 miles south of Tooele are:

1) August 11, 1968	67 cfs	5 year flood
2) June 24, 1969	155 cfs	16 year flood
3) June 1, 1973	125 cfs	11 year flood

Recent flooding in 1983 and 1984 occurred from snowmelt in Settlement Canyon and Middle Canyon Creek. The greatest flooding of 1983-84 occurred in 1984 when peak flows at Tooele were approximately 123 cfs in Settlement Canyon and 200 cfs in Middle Canyon Creek at respective recurrence intervals of 6 and 26 years.

Tooele has enlarged existing waterways on Settlement and Middle Canyon Creek, but not adequately for the 100-year flood events. Tooele has also grown much in size and is more vulnerable. The Settlement Canyon Reservoir, though effective for catching debris from debris flows, is not effective against the peak flows.

Wendover, Tooele County, Utah: A local hazard mitigation plan prepared by the State Hazard Mitigation Officer and a student Intern (Greg Gunnell) in 1994 documented the flood history and flood mitigation needs of Wendover. Additionally, a Flood Insurance Study (FIS) completed by FEMA/NFIP in 1996 (revised) both indicate that although flash flood potential continues to exist in the city, no flood-control structures have been built within the town of Wendover. Floodwaters emerging from the Leppey Hills to the north and west of Wendover first encounter Interstate 80 which does provide some protection before overtopping the freeway or finding their way to culverts or underpasses that pass beneath I-80. The city still experiences flooding. Mapped floodplains through Wendover proper are diffuse and difficult to

follow. The flood threat to Wendover is from thunderstorms, rather than snow due to the overall low elevation of the area.

Sanpete County: The main hazards facing Sanpete County are flash flood, snowmelt flood, wildfire, and severe winter weather. This countywide hazard analysis is for flood, but provides consideable information on Spring City, due ot its series of floods of July 1998.

The communities and rivers/streams of Sanpete County are:

Sanpete County Population: 20,000

Main Cities/towns:

Main City/County Seat:
Manti: Pop. 2,800
Manti Creek (floods on occasion)
Ephraim: Pop. 3,500
Ephraim Creek (floods on occasion)
Mt. Pleasant: Pop. about 2,100
Pine Creek/Twin Creeks (floods often)
Pleasant Creek (floods on occasion)
Fairview: Pop. 1,100
Cottonwood Creek (moderate, unless blocked by landslide)
San Pitch River (minor)
Fountain Green: Pop. 620
Log Canyon Ck/Uinta Creek/Gemmett Ck
Gunnison: Pop. 2,000
San Pitch (Moderate to Major)
Spring City: Pop. 800 (900, NS)
Oak Creek and Canal Ck (floods often)
Sterling: Pop. 300
Six Mile Ck (minor)
Wales: Pop. 250
Wales Canyon Ck (minor)
Mayfield: Pop. 500
1997. Twelve Mile Creek (moderate through The Order, is part of Mayfield),
otherwise minor. Landslides or log jams could aggravate the flood threat.
Centerfield: Pop. 850
1997. No main stream. Sevier and San Pitch River are closest; not threatening.
No serious flood threat; local runoff could be a problem.
Moroni: Pop. 1,400.
1997. San Pitch River (just the corner of town; moderate).
Fayette: Pop. 200.
There is a wash (Warm Creek, where a spring is located; minor) (Fayette Creek runs through

the middle of town and is generally dry; small watershed; minor) that comes through Fayette that has some flood potential. It may not be named. The Sevier River is nearby but generally poses no flood threat to Fayette.

Ground saturation resulting from snowmelt or thunderstorms is considered a major problem. There are many alluvial fans. Debris flows are common and can occur at any time, especially from summer thunderstorms, but also from snowmelt runoff. In the county, debris flows and landslides are a serious factor. Fairview and Canal Canyons are the worst, with a history of debris flows and landslides. In 1983 there was a landslide in Fairview Canyon that blocked the creek and destroyed the water line. The state highway (131) is damaged almost-yearly by sliding. Canal Canyon had two debris flows last in 1997. One was caused by a thunderstorm and another by snowmelt runoff. The channel carries the flows through Fairview, but not through Spring City.

There is county-wide risk on alluvial fans. Towns are built on alluvial fans; Spring City, Fairview, and Mt. Pleasant are all built on alluvial fans. Neither Spring City nor Fairview have debris basins. Spring City's method of mitigation is to divert the flow, dissipating it into a series of irrigation ditches. Manti and Ephrain both have debris/detention basins (function as both).

At Ephraim, they no longer have their detention basin. They have built homes across from where their man-made flood channel was built in 1983. The debsir/detention basin was a crusher pit. This filled in with sediment. The cul-de-sac is now the center of the old basin. There are settling ponds upstream that can hold some water. The hydro plant is in the channel of Ephraim's City Creek. They are placing a large water storage tank in the channel for culinary water supply; it may be treated there onsite. The hydro plant is in the county. It is moderately susceptible to floods. There may be a county Flood Insurance Rate Map (FIRM) covering this area.

At Spring City, there are several landslides in Canal Creek and Oak Creek that could block those creeks. Still, they do not seem to be active, or posing a major threat at the moment. It cannot be ruled out that some of these landslides could activate and cause flood problems. There weren't many landslides until 1983, and these are still present in the canyon walls.

Canal Canyon bridge was jammed with debris and flooded around the bridge. The upper county bridge has washed out perhaps three times in the past ten years. In 1983, when the floods occurred, the landslides caused some high water but no major problems. In the July 1998 flooding there were apparent surges suggesting natural dams in the canyons, but these were not major. These were also possibly caused by log jams in the canyons. The potential exists for larger surges, and with each flood event, the canyons should be flown and examined.

Recommendation: Fly the canyons during flood episodes to check for landslide problems.

In 1983, at Fairview, a natural dam formed and blocked Cottonwood Creek. Fairview was evacuated. Heavy equipment removed the natural dam. In Twelve Mile Canyon a boulder and debris jam blocked Twelve Mile Creek, east of Mayfield. No back-up flooding of property occurred, except for some

farmland. Mayfield is built on a bank and not on an alluvial fan. In pioneer times, the towns were located on the fans, but then through experience the towns were moved to higher ground.

A clay slip-surface (vein/layer) exists from Willow Creek to Milburn (all the way, from south to north end of Sanpete County). This surface, when lubricated, can cause massive landslides. It has now slipped through all of these canyons; this happened in Manti, Mayfield, Sux Mile, and some of it in Manti Canyon.

One indication of high velocities in Canal Creek in the 1998 flooding was the noise, which a person could hear for at least 1,000 feet. The water carried large boulders, up to five feet (diameter). Large trees, about one-foot diameter washed out of the canyon and jammed behind the bridges on Canal Creek.

It appeared from July 1998 floods that both large logs and boulders posed a serious threat to blocking the channels both in the canyons and on the alluvial fan. A field evaluation of Canal Creek Canyon showed many trees hanging on the edge of the scoured creek banks. This appears to be a main source of the debris. Trees also along the Canal Creek on the alluvial fan were underlined and went into the creek. There were about six or seven major log jams on Canal Creek and at least a few (likely two) on Oak Creek.

In 1998, water escaped from the channel of Canal Creek at each of the six or seven major log jam areas: 1) the upper County Bridge, 2) bridge on 12250 North, 3) the Lower Crossing Bridge, 4) the Canal Creek Crossing on Main Street, 5) Point Ditch Crossing on Main Street, and 6) Emergency Diversion on old Hwy 89. From these areas, water flowed as a sheet, or braided flow, across the fan mainly to the south of town (Spring City). The water was muddy in the early stages, described as soupy-concrete or like cake batter. The muddy mix "stacked-up" sometimes to eight feet higher on the fan. Lower on the fan, the flood water was described as simply muddy water that flowed a foot or two over the road.

Recommendation: The community of Spring City uses diversions and canals to divert flood waters away from town. That is the method of flood control. It is recommended that the damaged diversions be repaired and the channels cleaned. Beyond this, a debris/detention basin is recommended. Perhaps this could be designed in conjunction with one of the flood diversions. If the basin were built below a flood diversion on the main channel, the basin may only need to be half the size if it were built above the diversion.

Recommendation: Place a new SNOTEL site in the watershed of Canal Creek (7,500' elev.) and stream gage on Canal Creek at the upper diversion. Do a watershed calibration study on this watershed, plus a FLO 2D study for the Canal Creek alluvial fan.

During high runoff years like 1995, Ephraim and Spring City mainly experienced flooding of residential areas, with some at Mt. Pleasant. Manti also. In 1998, there were some culverts plugged from Canal Canyon and flooding and water came out of the banks. With the efforts of sand bagging, the flood waters were kept away from homes. Most of the damage to yards was from mud. There was some pretty significant mud build-up in the borrow pits along old SR 89. It appears that from the times of early development nearer Canal Creek, that residents moved more to high ground. There seems to be little recollection of early flooding into Spring City. In 1998, water got into three homes from the Oak Creek flood. None of the homes had basements (homes of Mike Workman, Marva Gusta, and Victoria Drake),

water came in beneath the doors and got perhaps three-feet deep.

In 1998, no businesses received flood water in Spring City. There could be some threat to commercial gravel operations.

In the 1998 flooding, approximately 40 acres of agricultural land were covered with mud (three different farms), plus a tree farm (unknown acres). Losses were mainly to hay and some rye. No other crops were involved. There were 105 tons of bailed hay destroyed. Three barns were damaged. Val Anderson of Farm Service Agency (FSA) examined these damages and applied for $35,000 to cover disaster losses.

In Ephraim, some flooding could affect a major dairy operations with much manure. There is a city ditch above his corals; there could be E. coli contamination all through town. This is right above Snow College. A few people have passed out from methane gas near the manure area. A concrete pit is created and the manure is placed there and feed water with a mixer to keep it stirred up, then the slurry is pumped into trucks to spray on the farm fields. People who get into the pits can be overcome from breathing the gas. If the creek above this person's dairy failed, then contamination could result and Snow College could be covered with manure and contaminated water. Ephraim Irrigation Company owns the canal that is uphill from the manure pit.

Recommendation for the Hazard Mitigation Grant Program (HMGP): Replace earthen canal embankments with a concrete-lined canal so that it may not breach. It might be a good idea to have some engineers look at this area. The threat is all down through the homes, campus and town. The downhill embankment could also be made higher (with concrete). If that canal breached anywhere along its full length, it flows along the city's east side, then the city of Ephraim would be flooded; the manure pit is simply an added feature. Cost. 300 feet of canal. $300,000, includes design.

Recommendation for the Hazard Mitigation Grant Program (HMGP): There is an irrigation, or water transport canal, in Ephraim, along College Ave. that threaten subdivisions. Besides the one described above. The canal is above the elevation of the adjacent residential areas. There are bridges that can fail, or block with debris, causing the water the creach and go through homes. Cost: At least 300 feet, plus elevate two bridges, $400,000.

OR

Construct new detention/debris basin upstream of Ephraim. $500,000.

Channel change has proven to be a problem at Spring City. On Canal Creek, the channel changed due to debris in the river.The floods on 1998 filled the channels considerably with debris. This happened twice with a need, back-to-back, to reestablish the channels. This was very expensive. It cost approximately $13,000 per day ($400,000 overall costs).

Conduits plugged
Water out of the Channel

Conduits plugging with water getting out of the channel is a general condition at Spring City during high runoff. This causes mainly damage to roads. There is the potential of breach resulting in increased flow. This has happened numerous times on several creeks throughout the county. Six Mile Creek has a place that washes out almost every year in this manner.

Irrigation canals being plugged is common in the county. Usually some structures plug at their diversions (after 1983 the county rebuilt almost every diversion). The county almost lost one diversion last year. It is not so common to lose them today. The structures on Canal Canyon are not really adequate, so these are the most vulnerable. In Spring City, there was damage to several diversion structures that normally transmit water away from the main channel of Canal Creek. Irrigation canals in Spring City (and adjacent county) serve for flood control. Most of the irrigation canals were plugged or washed out.

Across the county, there is little potential for loss of recreational features. There is also little reported loss of utilities from flooding. One example of lost utilities, however, was the loss at Spring City in 1998 of the U.S. West fibre-optics communications link to southwest Utah. This was a major expense for U.S. West and it also cause a significant disruption throughout central and southwest Utah.

Development of Spring City Flood Hazard Mitigation Plan: Appendix C11. Following the flash floods in Spring City, Sanpete County, on July 22 - 27, 1998, The State Hazard Mitigation Officer and Utah Interagency Technical Team (IAT) worked with Spring City and its residents to develop a flood mitigation plan. Among the recommendations, were the following needs:

1) Develop a FLO-2D debris flow model for both Canal Creek and Oak Creek. The U.S. Army Corps of Engineers, honoring a request from the Governor of the State of Utah, agreed to prepare a FLO-2D model for each alluvial fan. In preparation for this, the USACE required detailed topographic mapping of both fans. Spring City obtained a Community Development Block (CDBG) to fund the mapping and next hired Eaglescan, an aerial laser mapping company to do the mapping.

2) If the FLO-2D study indicated a need for entire fan flash flood/debris flow hazard mitigation to protect the community, then funding would be sought to construct a debris or detention basin on Canal Creek, and, perhaps, Oak Creek.

3) It was recommended that a SNOTEL site be placed on Horseshoe Mountain to enable area residents to monitor snow water equivalent and rainfall.

4) It was also recommended that an outreach program from the National Flood Insurance Program (NFIP) be established in Spring City to protect residents from financial loss in the event of a flash flood that might enter the community.

The recommendations listed above would be a major expense, and generally this would be difficult to justify due to the relatively small population of Spring City, about 900 people. The historical nature of Spring City, however, and the number of historic buildings (more than 200 on the National Historic Registry) provided

the needed emphasis.

The following text is provided to describe the flooding and information on the historic nature of Spring City, Sanpete County, Utah.

SPRING CITY, SANPETE COUNTY
HAZARD MITIGATION PLAN
MULTIPLE FLOOD EVENTS
July 22 and July 27, 1998

INTRODUCTION:

The Spring City, Sanpete County, Utah, flood hazard mitigation plan was developed in five phases during a time frame of August 7, 1996 to October 16, 1998. During this period, the Utah Interagency Technical Team conducted a vulnerability assessment of Sanpete County, including Spring City, then updated that assessment, and met with Spring City on August 19, 1998, following the July 1998 flooding in Spring City, to update the vulnerability assessment for Spring City. Each vulnerability assessment included mitigation recommendations, both county-wide and for Spring City (Appendix I). Following the flooding of July 22 and 27, 1998, two Interagency Technical Team ONSITE Reports were prepared, and the results are included in this Plan (Appendix II). Ultimately, on October 16, 1998, a hazard mitigation planning workshop was conducted at Spring City, involving government representative of the city and county, residents of Spring City (list of attendees included in Appendix III), and representatives of the Utah Interagency Technical Team (IAT).

THE FLASH FLOODS OF JULY 22 - 27, 1998:

Monsoonal storms concentrated on Sanpete County, Utah, from July 22 through July 27, 1998, producing flash flooding that resulted in an estimated $2.5 million in damages at historic Spring City (pop. 900; additional affected county pop. 200). Evacuations were implemented for both main events. The flood of July 22 began on Canal Creek at about 5:00 p.m. and began to subside at about 10:00 p.m. The flood of July 27 occurred on both Canal and Oak Creeks about 7:00 p.m. and lasted into the morning hours. Long-time residents indicate that this was the greatest flooding experienced to-date by the community. Two main flood events occurred five days apart, with numerous lesser but frightening intervening events. For example, on July 24, a storm settled again into the Canal Creek watershed. It began raining on Horseshoe Mountain about 6:00 p.m. The city was filling sandbags at 7:00 p.m. and residents of the south end of town were evacuated. About 7:30 p.m., residents of the alluvial fan had to "scatter the water" to different ditches because the water had already risen. Fortunately, the storm passed rapidly across and damaging flooding was alleviated.

No storm frequencies could be determined for these events because the area lies on the fringes of both the Salt Lake City and Cedar City Doppler Radar systems. At nearby Manti, one storm on July 24 dropped 0.81 inches of rain in 45 minutes equaling a 100-year storm event (State Climatologist data). Still, in contrast, on July 22, only 0.26 inches of rain was measured in Spring City, when the main Canal Creek Flood occurred; no figures are available for rainfall in the that watershed. High water marks and stream gradients allowed for estimates of flash flood surges (possibly not sustained flows) which reached discharges of about 2,500 cfs on Canal Creek which flows across the south side of Spring City, and of 2,400 - 4,000 cfs on Oak Creek which passes across the north side of Spring City. The causes of such amazing flows, likely surges, seems to have been major log jams within each canyon which left "debarked" logs perched 15 feet above stream banks high in Canal Creek Canyon (Temple Fork). Canal Creek has never had a stream gage, and, therefore, very little is known about historic discharges there. A U.S. Geological Survey stream gage at the mouth of Spring City Canyon (Oak Creek), abandoned in 1992 due to State funding cutbacks, suggests that a 100-year flood should produce some 400 cfs, which could have been equivalent to the sustained flows.

The floods of July 22nd and 27th on Canal Creek and then on the 27th on Oak Creek were described in similar terms by local residents as coming in viscous muddy surges that filled the channel immediately to a depth of four feet, then spread laterally across fields toward the city. The muddy mix had the consistency of soupy concrete or cake mix. Moving across the fields, the thick mud tumbled a debris-front of logs and boulders, stacking frequently to a depth of four or five feet, then shifting to other directions of flow. Mud depths of 10-12 feet were reported during the forward movement of the flood. Through this process, the debris flood spread across a width of about 1,000 feet, causing the emergency evacuation of the south end of town on the 22nd (Canal Creek), and then evacuations of both the south and north ends of town on the 27th (both Canal Creek and Oak Creek). On the 27th, twelve homes were reported damaged, the cities water supply system was damaged, losing two of three sources, causing restricted culinary water use throughout the community. Two county bridges were destroyed by major log jams and impacts from massive amounts of large boulders and two main diversion structures also used historically for flood control purposes, a hydro-diversion, and other diversions were destroyed or damaged. The city lost its only flood control systems on Canal Creek in both floods, causing a rush to restore flood control before the next storm. The city is repeating, for the second time in two weeks, spending an average of $25,000 per day for emergency cleanup and repairs; more monsoonal storms are forecast for the coming week.

HISTORIC SPRING CITY:

In 1979, the entire community of Spring City was designated a National Historic District, due to the presence of an estimated 160-200 historic buildings within the city limits. Only one other community, as a whole, in the nation shares this distinction, Colonial Williamsburg, near Richmond, Virginia. These homes built largely in the 1860's and 70's, preserve the best Utah example of original Mormon architectural heritage. Brigham Young paid many visits to this main stop along the main north-south Utah route. Orson Hyde, an early Mormon church leader lived here in a home built in 1865. The oolitic limestone for many of the homes was quarried three miles to the south by Mormon Danish settlers sent by Brigham Young. The homes were built on the ashes of the 1853 attempts of settlement following the Walker Indian War (Chief Wakara) and survived the Blackhawk Indian War (Chief Blackhawk) of 1865-69. The Utah Division of

History worked with the citizens of Spring City to obtain the original 1979 National Historic District designation, and then renewed the detailed documentation for renewal of this status in 1989, and they will do this again in 1999. The Utah Division of History includes Spring City in its Utah Tourism of Historic Sites Book.

Historic Spring City has faced floods since its earliest times, but the "old timers" describe floods of their memories back to 1934, when a severe snowmelt flood inundated Spring City for about two weeks. Another snowmelt flood struck the city in 1952 and again in 1983. A flash flood on Canal Creek just two years ago destroyed a county bridge. Numerous landslides formed above both Canal Creek and Oak Creek in 1983 and continue to threaten Spring City. At the present time, channel capacities are greatly diminished in both Canal and Oak Creeks. The historic city of Spring City is presently at much risk and the next monsoonal storm over the area could cause substantial additional damage to the city. While cities across the nation make great efforts to protect historic structures, efforts must be made here to protect an entire historic community. This requires special considerations at all levels of government, not only for disaster recover, but also for flood hazard mitigation.

THE SPRING CITY EMERGENCY PHASE:

Spring City considered itself in an emergency phase of debris removal throughout the monsoonal period, trying to protect itself from additional storms, just as it did following the July 22 storm, when it experienced a similar event on July 27. More storms are forecast and the monsoonal weather pattern continued through mid-September. The Canal Creek Canyon watershed had also been damaged by a wildfire. The watersheds of both Canal and Oak Creek were saturated. The channels in both Canal and Spring City (=Oak Creek) Canyons remained incised (damaged from scouring) and fully loaded with additional boulder and timber debris, ready to repeat the flood damage of July 22 and 27. Relatively small storms were causing a quadrupling of flow in Canal Creek. The Natural Resources Conservation Service (NRCS) sent an evaluation team consisting of the District Conservationist, State NRCS Engineer, and State NRCS Geologist, and they determined that watershed and weather conditions warranted "exigency measures" to clean debris from the channels; unfortunately their available funding did not include badly-needed mitigation funding, as could be made available from the Federal Emergency Management Agency (FEMA/404 and 406 mitigation programs). Additionally, the U.S. Army Corps of Engineers allowed Spring City to clean channels under an emergency 404 permit. The State Interagency Technical Team (IAT), and county emergency workers, agreed that additional flooding will happen if similar storms concentrate on this area.

FEMA EVALUATION FOR POTENTIAL PRESIDENTIAL DECLARATION:

The magnitude of flood damage, estimated by the city at about $2 milliontotal, warranted an evaluation by the Federal Emergency Management Agency (FEMA) for a potential Presidential Disaster Declaration. This evaluation was conducted on August ???, 1998, by two FEMA representatives, Dave Prothero and Dan Carlson. There were several exclusions as to what FEMA would not consider as qualifying for federal disaster assistance. For example, the major expanse to the city was channel cleaning. This type of work would not qualify because the emergency was over, according to FEMA - the flood had ended. The

remaining dollar costs for damages were not sufficient on a countywide nor a statewide basis to qualify for a Presidential Disaster Declaration.

PAST PRESIDENTIAL DISASTER DECLARATIONS:

Sanpete County was included in Utah's Presidential Disaster Declarations of 1983 and 1984. In 1983, 13 local entities were involved, including Spring City. There was no Section 404 Hazard Mitigation Grant Program in 1983 and 84, and not all mitigation could not be accomplished. Damaged bridges were mitigated to 100-year flood standards. In 1983, a debris flood and other high water caused damage to Spring City's municipal power plant and culinary water lines. This damage has been repeated again in the present floods of July 22 and 27. In 1983, the impacted entities of Sanpete County, including Spring City, received Public Assistance for 1) debris clearance, 2) protective measures, 3) road systems, 4) public utilities, 5) and "other", for a total amount of $1,626,180. In 1984, damage estimates for San Pete County and 11 other entities reached $1,088, 687. FEMA authorized $315,694 for restoration of damages and for general cleanup and emergency work. FEMA wrote-up Damage Survey Reports in the amount of $1,842,847 for the 11 separate entities and the county.

The flood events of 1983 and 1984 have left their scars on the watersheds of both Canal Creek and Spring City Canyons, where landslide scars continue to mark the lower canyon walls adjacent to the streams. IAT reconnaissance of the past two weeks, both from fixed wing aircraft, helicopter, and on the ground indicate that the landslides of those years still exist and may threaten blockage to the channels. In 1983, a large landslide in Spring City Canyon did block Oak Creek and cause a major flood surge. That landslide is still present, as are others, even seemingly new ones. As the monsoonal season proceeds, and then spring snowmelt occurs, the damaged watersheds will continue to present an unusually high threat to the community of Spring Creek.

Sevier County: Sevier County has not experienced any emergencies caused by natural hazards in the past decade that have required the assistance of the Utah Interagency Technical Team. Still, the County was included in the Presidential Disaster Declarations of both 1983 and 1984. The County is scheduled for a detailed hazard and risk analysis this year. The County has also expressed an interest in Project Impact, especially for the city of Salina. Richfield apparently has little flood threat and risk. In the 1983 flooding, the communities of Elsinore, Monroe, Richfield, and Salina all experienced flood that were estimated to be less than 100-year events. Elsinore actually had no flood damage but did lose a culinary water line where it crossed the Sevier River. Monroe experienced a flash flood that came from Monroe Canyon. Roads, culverts, and an irrigation structure were damaged. Water lines were damaged and so was the penstock for Monroe's power plant. Most of the population of Richfield is on high ground and not vulnerable to much flooding from the Sevier River. Infrastructure in the lower part of the valley were threatened, including water and sewer lines, including a sewer line from the hospital. A bridge over Cottonwood Creek failed. The city of Salina suffered damages from debris flows and floods. Major damages occurred to the city culinare water system, sewer plant, and pressurized irrigation system. The city staged a $27,000 flood fight, which included riprapping the banks of Salina Creek and sandbagging.

Beaver County: Beaver County was included in the Presidential Disaster Declaration of 1983, but not 1984. Additionally, in the past decade, the Utah Interagency Technical Team has not been called to assist this county with flooding, or other hazards. In 1983, floodwaters from the National Forest lands inundated Beaver County properties and agricultural land. Although no homes were damaged, private crop lands suffered from heavy silt deposits. Public damages to bridges, roads, and culverts, as well as flood fight costs, totaled $442,726. In Beaver, the county's largest city, the city power plant was flooded, forcing the city to purchase alternate power for three months.

Piute County: Piute County was included in the Presidential Disaster Declaration of 1983, but not that of 1984. The Utah Interagency Technical Team was called to assist Piute County in 1988 when monsoonal thunderstorms struck the watershed above the Kingston Canyon section of the East Fork of the Sevier River with headwaters at Bryce Canyon. Below is an excerpt from the IAT ONSITE Report for that flood.

> "At the request of Sheriff Cordell Pearson, Piute County Emergency Management Director, on Thursday, August 28, 1997, the IAT traveled to Kingston Canyon, near the town of Kingston, Piute County, to evaluate the effects of the flash flood that occurred on Friday afternoon, August 22, 1997. Original notification to the IAT came on Saturday afternoon, August 23, 1997.
>
> The flash flood was caused by an intense monsoonal flow thunderstorm in the watershed above the north side of Kingston Canyon (north end of Mt. Duton and south end of Forsae Mountain) and State Road 62. This storm dropped up to three-inches of rain in two hours. According to the State Climatologist's Bulletin No. 1, similar storms in the Richfield (1.16"/2 hrs = 100 year storm) and Koosharem (1.47"/2 hrs = 100 year storm) areas would be considerably greater than a 100-year storm. The flood frequency is still being determined by the U.S. Geological Survey. A USGS river gage (10189000, East Fork Sevier River near Kingston, UT) recorded a record stage of 8.29 feet; the previous record was 7.35 feet measured on August 27, 1929. The gage measured a discharge of 1,000 cfs during the August 22, 1997 flood, which is not a record discharge, but is estimated at a 10-year flood. The contradiction between record stage and non-record discharge is presently being addressed by the USGS. They feel that backflow from a downstream tributary caused the record stage, but that the discharge may be accurate at 1,000 cfs. Due to flows and road blockages, SR 62 was closed from 4:00 p.m. on Friday until 2:00 p.m. on Saturday. The floods emerged from numerous (estimated 15 side-canyons over a six-mile distance of canyon) small to large side-canyons flowing southward across their alluvial fans, then across SR 62, then into the East Fork of the Sevier River. An estimated 35 automobiles were stranded between the canyon-mouth flood sites.
>
> There were two separate types of flooding. The first was alluvial fan flooding, where water was described (at one site) as topping a stop sign where the Monroe Moutain County Road intersects SR 62. Judging this depth suggests that high-velocity water may have flowed across SR 62 as deep as 8-feet. In places, sediment, boulders, and tree/brush-debris was deposited six-feet deep on SR 62. The second type of flooding was riverine, where the side-canyon flows accumulated to some depth in the river channel (see stage information below).

Two of the more severe impacts were the loss of several hundred feet of culinary water pipeline that ran along the south side of SR 62, and the loss of approximately one-mile of county-maintained dirt road (Monroe Mountain Road) that passes from SR 62 miles northward into the Forsae Mountain area, eventually (40 miles) connecting with communities, such as Monroe, Antimony, and Koosharem. The road is made of native materials.

The IAT determined that there was severe threat to life and property as a result of the flood. It was fortuitous that no automobiles had been washed into the river and that neither the river nor the bridge had been blocked by debris leading to higher flood surges.

MITIGATION AND RESTORATION:

Repair/Resporation of Culinary Water Line for Kingston: The culinary water line that passes from a set of springs on the south side of Kingston Canyon to the town of Kingston was both broken and filled with sediment. Bob Rasely, Geologist, Natural Resources Conservation Service/Emergency Watershed Protection Program (EWP), determined that repairs and mitigation could possibly be made under the non-exigency element of the EWP. Mr. Rasely explained his program to the Piute County Emergency Management Director, Cordell Pearson and to the Mayor of the town of Kingston, Len Mills, and established a process to apply for EWP funding. The county and city is presently applying for EWP funding.

Repair of Damaged River Channel within the East Fork of the Sevier River: Much debris washed into the East Fork of the Sevier River and some downstream canals., changing the river's gradient and the composition of the river bed, creating an unstable flow regeime. Bob Rasely recommended that EWP be implemented to repair and mitigate the affected reach of river (from Lion Rock east to Kingston; approximately three miles).

County Road North From Kingston Canyon: Monroe Mountain Road extends northward from Kingston Canyon to Forsae Mountain and to Monroe, Antimony, and Koosharem. Approximately one-mile of this county-maintained road (native materials except for a few culverts) was severely damaged by the flash flood and should be repaired. The county has indicated that they would ask for state assistance to do this repair through the emergency declaration process. No mitigation measures were recommended, only restoration.

Flash Flood Warning Signs: The IAT concurred that due to the rocky-nature of the watershed and close proximity of the side-canyon-mouths, that flash flood potential was ongoing. July and August floods are relatively common. It was recommended that signs be placed on SR 62 at both ends of the canyon indicating the potential for flash flood and that travelers should exercise caution during thunderstorm periods. This mitigation measure should be considered by UDOT."

Given this record, going back to 1983 (16 years), it appears that Piute County is vulnerable to heavy snowpack melting, as well as flash flooding, but that such occurrences are not common. The 1983 record indicates that Piute County's flooding damaged roads, bridges, culverts, and agricultural interests. Farm

lands were inundated with water and eroded. Irrigation facilities were damaged. A covered bridge was damaged by flood waters at Kingston. There was minimal damage to homes, and then involved basements. Major damage to private agricultural property rendered 4,000 acres temporarily or permanently unusable. This impacted the county for a long time, since agriculture is is the county's primary economic base. Much mitigation was done following 1983, including raising bridges and improving irrigation systems. A two mill flood levy only raised $13,243. At Marysville, heavy snowpack flooding into Bullion Creek caused flooding damage to to bridges and water lines. The stream beds filled with debris and the flow left the channel. Damage to personal property was slight. Little mitigation was completed, although the channel was cleaned.

Wayne County: Wayne County was not included in either the Presidential Disaster Declarations of 1983 or 1984. The Utah Interagency Technical Team has not been called to assist the county over the past decade. This suggests a relatively safe county from the standpoint of natural hazards, with little history of threat from natural hazards. Flooding is reported almost every summer as a result of flash floods above Capitol Reef National Monument. These result from monsoonal storms that go into the Thousand Lake Mountain (11,000'+) area to the north of Capitol Reef and into the Boulder Mountain (11,000'+) area to the south. These watersheds drain into the Fremont river drainage that passes through the Navajo Sandstone country of Capitol Reef. There is little infiltration of the runoff and flash floods result, threatening mainly tourists. Generally, these flash floods come and go with little impact to people.

Iron County: Iron County was not included in the Presidential Disaster Declarations of 1983 and 1984. Still, the Uintah Interagency Technical has been called out on various occasions, such as for the 1989 flash flood that emenated from Fiddlers, Dry Fork, and Stevens Canyons into alluvial fam residential areas. This ONSITE involvement is documented in Appendix C5. This provides the State Hazard Mitigation Team with an excellent view into alluvial fan flooding at the base of a major Utah plateau, the Markagunt Plateau, upper elevations 11,000' MSL. These types of fans have abrupt changes in elevation and slope at the base of the plateau. The Utah IAT was called out in 1998 to address flash flooding on Red Creek at Paragonah. This flooding is periodic and threatens the community which is built on the lower end of the fan (sheet flow zone). Fortunately, the fan is not developed in the braided or high velocity zone. Historic flooding here has done very little damage to homes and roads, but the threat could escalate under a combination of snowmelt and rainfall conditions.

WILDFIRE IN UTAH

Wildfire has been addressed extensively in Utah, with two State Hazard Mitigation Plans and two local hazard mitigation Plan (Wasatch Mountain Wildfire and Summit County Wildfire). This could be documented here, within this text, but it is so well documented in the appendices that the readers are referred to those documents: Appendices B5, B7, C8, C9, and C10. Statewide wildfire hazard analyses and mitigation measures are addressed. The Urwin and Wufi Children's Program is also addressed in Appendix C10. This was piloted in Summit and Wasatch Counties, as is documented in Appendix C9. The Urwin and Wufi children's program, Adventure with Wildfire, has proven very successful within Utah and elsewhere, in educating children in how to live safely in the URWIN areas.

The State Hazard Mitigation Team, and statewide schools with internet capability can now teach third graders electronically about wildfire mitigation on FEMA for Kids at:

http://www.fema.gov/kids/

If the school has a computer room with internet capability, or if you chose to invite the kids to your EOC and you have internet there, the kids can "click and color" using the Urwin and Wufi Children's Coloring Book. You can relate the story to them and ask the kids to pass that information on to their parents. They may make a better advocate with their parents than others.

HAZARD MITIGATION RECOMMENDATIONS

1999

This section of the State Hazard Mitigation Plan presents hazard mitigation recommendations based on the results of local hazard mitigation plans, Interagency Technical Team ONSITE Reports, and county vulnerability and mitigation assessments. This is a living document and this section especially can be added to as time passes. Hazard mitigation recommendations are not requirements to be implemented but recommendations. It is clear that local governments over the years in Utah have implemented much mitigation, making Utah relatively safe from hazards on a general basis. These arrays of recommendations will be circulated through the State and discussed for mitigation possibilities. Hopefully, many will be implemented. An examination of previous State Hazard Mitigation shows that much has been implemented from those plans. These recommendations, below, are the result of much experience by the Utah Interagency Technical Team in working with communities over the years. They generally represent much "hands-on" experience with natural hazards statewide, and in this sense should generally be implemented wherever possible. Still, they are recommendations and provided to the State as helpful suggestions on what to do to continue to reduce vulnerability to Utah's hydrologic hazards. Recommendations that relate to specific communities and counties would generally be implemented locally, but the Utah Interagency Technical Team is available to assist upon request, or to make suggestions if funding resources become available.

HAZARD MITIGATION GRANT PROGRAM (HMGP)

PROJECT LISTING

The following list of potential Hazard Mitigation Grant Program (HMGP) projects is taken from the portion of this State Hazard Mitigation Plan describing mitigation needs in several of Utah's counties, based on county hazard analyses prepared by the State Hazard Mitigation Officer. The reader will need to review that section for details (also see Appendix A14). Each recommendation that is accepted as an HMGP project is marked by an asterisk in that body of text (also marked here below).

Box Elder County:

*** Recommendation:** Construct levees around the Corinne Sewage Treatment Lagoons to protect them from flooding of the Bear River.

Cache County:

*** Recommendation:** A permanent stream gage (real-time transmitting) should be placed above the UP&L Dam in Blacksmith Fork Canyon.

DAVIS COUNTY:

The **recommendations** identified in the Centerville, Davis County, Community Action Plan, for Project Impact, should be considered part of the State Hazard Mitigation Plan, as should the Centerville Flood Hazard Mitigation Plan. Those not implementatble through Project Impact, or imnplemented by the time of the next Presidential Disaster Declaration, are considered to be part of the project listing for the Utah Hazard Mitigation Grant Program.

Morgan County:

Recommendation: Several areas along East Canyon Creek should receive rip rap and debris removal.

*** Recommendation:** Replace Devil's Slide Bridge across the Weber River at Devil's Slide.

*** Recommendation:** Place berms around the schools in Morgan. Perhaps berms should be placed around the back side of the high school.

*** Recommendation:** Place berms around the Morgan Health Center.

*** Recommendation:** Construct levees to protect older areas in Peterson. Emergency levees do exist there now; these were not engineered. Engineered levees would be an improvement. One-half mile of levee is recommended.

*** Recommendation:** Levees along the Weber River near the City of Morgan are at about a 30-year flood elevation. Levees would be helpful through Morgan. Place 100-year levees.

*** Recommendation:** Open Space Preservation: The community can set aside special flood hazard areas as public open space. The acquisition of land along the Weber River to create a parkway to benefit the tourism within the City can be explored.

Salt Lake County:

The **recommendations** identified in the Salt Lake City, Salt Lake County, Community Action Plan, for Project Impact, should be considered part of the State Hazard Mitigation Plan, as should the Salt Lake Flood Hazard Mitigation Plan (being prepared). Those not implementatble through Project Impact, or imnplemented by the time of the next Presidential Disaster Declaration, are considered to be part of the project listing for the Utah Hazard Mitigation Grant Program.

Sanpete County:

*** Recommendation:** Construct a debris basin at the mouth of Canal Creek Canyon to protect the historic district of Spring City.

Recommendation: Dairy farm manure bunkers located in the floodplain above Ephriam and the Snow College Campus should be protected by levees to prevent contaminated flood waters from reaching the campus.

Weber County:

Recommendation: Protect river banks from erosion by starting new growth by planting river bank vegetation.

STATEWIDE MULTI-HAZARD RECOMMENDATIONS

Adopted from Interagency Technical Team (IAT) Onsite Reports

To view additional recommendations, review the prior section identifying the goals and objectives of the State Hazard Mitigation Program (SHMP), including Project Impact, and of the State Hazard Mitigation Officer.

The recommendations presented below are the result of several years of interactions with local government officials through IAT ONSITE interactions.

STREAM GAGES AND INSTRUMENTS:

Recommendation: During flood periods coordinate with U.S. Geological Survey on establishing transmitting stream gages at places of concern. When other opportunities present themselves, such as through Project Impact, stream gages should be included in a local hazard mitigation effort.

Lead Agency: IAT Coordination; Utah Division of Water Rights; U.S. Geological Survey.
Time Frame: Ongoing
Cost: None, although transmitting stream gages cost approximately $20,000; there is a possibility of a cost-share through The Utah Division of Water Rights.
Existing Mitigation:

Recommendation: During flood periods coordinate with U.S. Natural Resources Conservation Service, Snow Survey Office, on establishing transmitting SNOTEL sites at places of concern. When other opportunities present themselves, such as through Project Impact, new SNOTEL sites should be included in a local hazard mitigation effort.

Lead Agency: IAT Coordination; Utah Division of Water Rights; Natural Resources Conservation Service.
Time Frame: Ongoing
Cost: None, although transmitting SNOTEL sites cost approximately $20,000, NRCS will maintain the sites and place the real-time data on the internet.:

Recommendation: Have on-hand mobile real-time transmitting stream and precipitation gages that can be positioned strategically during times of concern about flood.

Lead Agency: U.S. Geological Survey
Time Frame: One Year
Cost: Perhaps $40,000
Existing Mitigation: The U.S.G.S. has a few such gages at the present time.
Implementation Strategy: Seek funding for an adequate number for deployment statewide, as needed.

Recommendation: Conduct watershed studies to calibrate between transmitting stream gages and SNOTEL sites.

Lead Agency: National Weather Service
Time Frame: Ongoing
Cost: Perhaps $2,000 per study.
Existing Mitigation: The NWS has the capability to do this studies and does them routinely.

Implementation Strategy: Seek funding for studies as stream gages and accompanying SNOTEL sites are established.

HAZARDS MONITORING, REPORTING, AND ACTIVATING:

Recommendation: The Utah Interagency Technical Team should be expanded to include a full component of State agencies, and activate when called upon by County Emergency Management Directors during times of concern about natural hazards and/or times of emergency.

Lead Agency: Utah CEM
Time Frame: One Year
Cost: None
Existing Mitigation: The IAT is geneally well-staffed, but requires additional agency representation.
Implementation Strategy: Request the Commissioner of Public Safety expand the IAT through letters to appropriate Division Directors. Also, send letters to existing IAT members requesting ongoing support, emphasizing the value of the IAT in its services.

Recommendation: Following wildfire burns adjacent to population centers, the Utah IAT should work through the County E.M. Directors to give a multi-disciplinary presentation on the potential for flash floods. NRCS/EWP should follow-up with post-burn hazard mitigation exigency measures.

Lead Agency: Coordinated by Utah CEM
Time Frame: Ongoing
Cost: None
Existing Mitigation: The IAT performs this function, and it should be continued.
Implementation Strategy: Monitor wildfire locations and act when a community is involved.

Recommendation: The Utah Division of Comprehensive Emergency Management should meet with other Division Directors to keep them aware of the needs of mitigation activities of the Utah IAT.

Lead Agency: Utah CEM, Division Director
Time Frame: Beginning now and quarterly.
Cost: None
Existing Mitigation: The IAT, at present, is supposed to keep their agency management aware of IAT activities.
Implementation Strategy: Utah CEM Director could send quarterly invitations to other agency Directors.

Recommendation: During times of concern about flood, provide coordination for multi-agency technical input for snowpack/snow-water-equivalent, river discharges, peak flow periods, and other technical information. This should become a standardized service of the

Interagency Technical Team through the Utah Division of Comprehensive Emergency Management.

Lead Agency: State Hazard Mitigation Officer and IAT Coordinator
Time Frame: Ongoing.
Cost: Likely no cost.
Existing Mitigation: The Utah IAT coordinator annually involves the Utah IAT in this process and it should continue.
Implementation Strategy: Obtain agreement from CEM management that this should be done on a more routine basis throughout the year, not just during typical seasonal periods (springtime snowmelt period).

Recommendation: Establish internet connection between IAT and county technical and emergency management officials for updates on statewide hazard potential.

Lead Agency: Utah CEM as coordinating agency
Time Frame: Ongoing
Cost: None
Existing Mitigation: Some county emergency management directors have internet capability, and more should have it shortly.
Implementation Strategy: Develop a weekly webpage on Utah's statewide hazard condition.

Recommendation: Following flooding that significantly damage or alter river channels in developed areas, the changes should be reported to the FEMA Region VIII NFIP office for remapping considerations, provided NRCS does not re-establish the channels. The NRCS should coordinate with NFIP officials when modifying river channels.

Lead Agency: The IAT should notify the State NFIP Coordinator when FEMA-mapped channels have been altered by flooding and NRCS will fund projects to restore them, which could modify them.
Time Frame: Ongoing
Cost: None
Existing Mitigation: The State NFIP Coordinator is generally invited to visit flood sites with the IAT.
Implementation Strategy: Invite the State NFIP Coordinator to go onsite with the Utah IAT when flooding may have damaged mapped stream channels.

Recommendation: The Utah NFIP Coordinator could use flood events as opportunities to promote flood hazard mitigation, including planning. The Coordinator could go onsite with the IAT for flood events.

Lead Agency: Utah CEM
Time Frame: Ongoing
Cost: None - Minimal for travel
Existing Mitigation: Currently the NFIP Coordinator has not joined the IAT for this service.
Implementation Strategy: Utah CEM/State NFIP Coordinator should consider this need and opportunity.

Recommendation: During times of concern about flooding, when SNOTEL sites are available, the sites should be programmed to provide data each 15 minutes.

Lead Agency: Utah CEM and Utah IAT coordinate with NRCS Snow Survey Office
Time Frame: Ongoing
Cost: None
Existing Mitigation: This is presently being done and should be continued.
Implementation Strategy: When a local government requests this kind of assistance it should be made available. The IAT Coordinator or a team member can make the request.

Recommendation: Television monitors in the State Emergency Command Center could be trained on critical electronic data bases for management awareness of situations.

Lead Agency: Utah CEM
Time Frame: Ongoing
Cost: None
Existing Mitigation: The Operations Manager has the capability to do this now.
Implementation Strategy: The operations manager can select electronic data bases on available websites when emergencies occur.

Recommendation: When avalanches occur, the IAT should inquire as to the potential for natural ice dams on rivers and if the local government requires assistance to evaluate and mitigate the situation

Lead Agency: County Emergency Management Directors make the request to
Time Frame: Ongoing
Cost: None
Existing Mitigation: Mechanism is in place; local governments only need an awareness of who to call.
Implementation Strategy: Instruct County E.M. Directors on uses of Utah IAT.

Recommendation: The IAT should be able to respond rapidly to hazard-caused events with fixed-wing and helicopter flights to give the local government a knowledge about their situation

Lead Agency: Utah CEM Coordinates
Time Frame: Ongoing
Cost: Covered by Department of Public Safety flying budget
Existing Mitigation: This has been done for several years and should be continued. Local officials should be aware of this service.
Implementation Strategy:

Recommendation: The Utah IAT should have an ongoing relationship with National Park Service technical staff who monitor weather conditions in somewhat rural areas.

Lead Agency: Utah CEM
Time Frame: Six months
Cost: None
Existing Mitigation: The capability exists, but only a networking arrangement needs to be accomplished.
Implementation Strategy: The Utah IAT Coordinator will contact NPS park headquarters' offices in Utah to determine names and make lists of people and capabilities.

Recommendation: The Utah IAT should include the State Historical Preservation Officer (SHPO) when evaluating flood risk in threatened communities.

Lead Agency: Utah CEM
Time Frame: One month
Cost: None
Existing Mitigation: A SHPO exists in Utah and would likely agree to serve on the IAT.
Implementation Strategy: The Utah IAT Coordinator will obtain information on how to arrange this with the SHPO and the Utah CEM Director could send a letter to the SHPO's management requesting this assignment.

Recommendation: The Utah IAT should identify potential funding resources for damaged irrigation structures that may in turn threaten communities with flooding, if they were to fail.

Lead Agency: Utah Department of Agriculture and NRCS
Time Frame: One year
Cost: None
Existing Mitigation: Little is known about this need. It must be researched.
Implementation Strategy: explain the need to the Utah Department of Agriculture and NRCS and have them provide an assessment of potential resources.

EDUCATION:

Recommendation: The Urwin and Wufi Children's Program should be continued annually statewide and enhanced with various versions to address the various issues of Urban Wildland Interface Wildfire.

Lead Agency: Utah Division of Forestry Fire and State Lands and Utah CEM
Time Frame: Ongoing
Cost: $4,000 per year
Existing Mitigation: Presently, the State Hazard Mitigation Officer and State Wildfire Suppression Manager have $4,000 for this years books. We need to identify $5,000 for next year to expand the program and create one or two new versions.
Implementation Strategy: In coordination with FFSL, the State Hazard Mitigation officer will seek funds from FEMA, or a corporate sponsor to continue to publish and create the books.

Recommendation: County Emergency Managers should be trained in principles of hazard mitigation.

Lead Agency: Utah CEM - State Hazard Mitigation Officer and Training Section.
Time Frame: Ongoing
Cost: $10,000 per year
Existing Mitigation: A new Utah CEM course on Hazard Mitigation is being offered for the second time. It will be ongoing.
Implementation Strategy:

Recommendation: Local governments should be educated on the lack of mitigation funding and resources for landslide damage and on the experiences that communities have had during times of landslide.

Lead Agency: All IAT agencies
Time Frame: Ongoing
Cost: None
Existing Mitigation: The NRCS has indicated its lack of willingness to provide funding for damaged stream channels in hazardous locations
Implementation Strategy: Request the assistance of the Utah IAT agencies

Recommendation: County Emergency Managers should be trained in the rapid use of the Utah interagency Technical Team.

Lead Agency: Utah CEM and other State agencies
Time Frame: Ongoing
Cost: None

Existing Mitigation: Utah CEM does make the IAT's presence known, but only on occasion and not systematically.
Implementation Strategy: Make an IAT brochure and distribute it. Have the IAT prominent on the Utah CEM website.

Recommendation: Eligible communities in Utah should be kept aware of Project Impact and its philosophies so that Utah can adopt these concepts and become disaster resistant.

Lead Agency: Utah CEM and other state agencies
Time Frame: Ongoing
Cost: None
Existing Mitigation: Utah CEM is currently promoting the program statewide.
Implementation Strategy: All CEM programs, and community programs of other agencies, should promote Project Impact and its concepts statewide.

Recommendation: Utah will continue to be a supporter of and participant in the Project Impact Program.

Lead Agency: Utah CEM will coordinate the nomination of the FY99 Project Impact Community and continue to assist the FY98 community, Centerville to be successful with Project Impact.
Time Frame: Ongoing
Cost: None - as funded by FEMA.
Existing Mitigation: A Utah Project Impact Coordinator has been assigned under the State Hazard Mitigation Program (SHMP). The FY98 community was successfully selected and presently conducting its responsibilities.
Implementation Strategy: Continue with the Project Impact Progam as outlined by FEMA.

PROGRAMS:

Recommendation: Seek matching State Hazard Mitigation Funds for Project Impact, or to select a second Utah FY99 Project Impact Community.

Lead Agency: Utah CEM
Time Frame: This Legislature
Cost: $500,000 per year
Existing Mitigation: No such fund presently exists
Implementation Strategy: Prepare the necessary requests for legislative funding.

Partnerships:

Recommendation: The IAT should create corporate partnerships to fund awareness campaigns for multi-hazards. For example, Farmers Insurance might fund brochures on wind damage mitigation.

Lead Agency: Utah CEM
Time Frame: Ongoing
Cost: None, except to corporations
Existing Mitigation: Project Impact is being quite successful at this nationwide.
Implementation Strategy: Contact corporations to become private sector partners in making Utah disaster resistant.

Recommendation: The Utah IAT should document all ONSITE activations and the physical evidence of the events for educational/training purposes.

Lead Agency: Utah CEM
Time Frame: Ongoing
Cost: Very little; video tape; film
Existing Mitigation: The Utah has documented active hazards for the past decade and has a library of such visual materials.
Implementation Strategy: Continue to collect and use these materials.

Recommendation: The Utah IAT should participate in hazard events for two purposes, 1) to assist local governments, and 2) to obtain valuable experience with hazards prior to major future events.

Lead Agency: All IAT agencies
Time Frame: Ongoing
Cost: None
Existing Mitigation: The IAT has received such training on an ongoing basis for the past decade.
Implementation Strategy: The IAT should continue responding to county requests for IAT assistance, to assist the counties, and to provide training to IAT members.

Recommendation: A study should be conducted to identify locations where rural land has been converted to urban/residential creating a potential flood threat from aging irrigation canals.

Lead Agency: Utah CEM - State Hazard Mitigation Officer
Time Frame: One year - following drought mitigation plan completion

Cost: $20,000
Existing Mitigation: Preparing Mendon, Cache County, Flood Hazard Mitigation Plan.
Implementation Strategy: Obtain funding from USDA, Rural Development Agency, or a similar entity and begin the study.

Recommendation: Apply HAZUS for flooding to communities statewide, once the software is developed.

Lead Agency: Utah CEM, in coordination with FEMA HAZUS workers.
Time Frame: As soon as software is available.
Cost: Perhaps no cost; a laptop computer may be required.
Existing Mitigation: HAZUS now exists for earthquake loss estimation and is being developed for flood loss estimation.
Implementation Strategy: Obtain training and equipment, once the software is available. Establish a schedule with communities.

Recommendations: Help local governments to become aware of the funding limitations of NRCS/EWP in areas that become developed and are deemed intrinsically hazardous by NRCS.

Lead Agency: IAT agencies
Time: Ongoing
Cost: None
Existing Mitigation: Present awareness of NRCS' position on this kind of assistance.
Implementation Strategy: Request the assistance of the IAT to relay this information to local governments, requesting their assistance in preventing development in hazardous areas.

FUNDING:

Recommendation: The Utah IAT should have an annual funding workshop, where federal and state agencies are invited to report on hazard mitigation funding opportunities.

Lead Agency: Utah CEM
Time: ix months
Cost: None
Existing Mitigation: We have a knowledge of most funding sources, but likely not all. Local officials, as well as the IAT, should receive training on this sources.
Implementation Strategy: Set a date for the training and invite the various known resources and others that we can discover through an inquiry.

Recommendation: The Utah IAT should continue to represent local governments in identifying projects

for the NRCS/EWP, Community Impact Board, and Emergency Community Development Block Grants.

Lead Agency: Utah CEM and IAT agencies
Time: Ongoing
Cost: Cost annually to NRCS is perhaps $400,000 - $500,000 in Utah.
Existing Mitigation: The IAT has represented NRCS, CIB, and CDBG on an ongoing basis for years.
Implementation Strategy: Continue the relationship.

IRRIGATION CANALS:

As more and more agricultural land is converted to urban and residential use, new homes are being built in close proximity to aging irrigation canals. In many cases, these canals are elevated above the lay-of-the-land and when they do breach or overtop, water flows often toward new homes. Such floods have occurred recently in Lindon, Utah County; Draper, Salt Lake County; Mendon, Cache County; Vernal, Uintah County; and others.

Recommendation: Land converted from agricultural use to urban-residential use that faces flood threat from adjacent, elevated, and aging irrigation canals should be viewed as high flood-risk areas. Such areas may require special considerations in providing emergency mitigation when flooding is anticipated. Such considerations could include temporary waiving of environmental regulations protecting water quality, stream channels, and adjacent wetlands. The recognition of such high-risk areas as being high risk, would also warrant determining concern thresholds when local flood control officials could take action to protect the community with emergency mitigation, including steps that might otherwise violate Federal and/or State environmental regulations.

Lead Agency: Utah CEM and IAT agencies
Time: Ongoing
Cost: None
Existing Mitigation: Emergency Section 404 permits are available.
Implementation Strategy: Continue the relationship.

COUNTY FLOOD HAZARD MITIGATION RECOMMENDATIONS

The Utah Interagency Technical Team (IAT) develops flood hazard and vulnerability analyses and mitigation recommendations for counties. As counties are completed, the associated recommendations will be added to this plan, and the listing of potential HMGP projects. Flood mitigation information is used for two purposes: 1) in the event of a Presidential Disaster Declaration, some of these projects could be funded through the Hazard Mitigation Grant Program and 2) upon request of the counties, the Utah Interagency Technical Team can assist in finding implementation resources.

Note: The recommendations marked by an asterisk are considered as part of the State Hazard Mitigation Program Grant project listing.

BOX ELDER COUNTY:

Recommendation: Monitor flooding in agricultural areas for potential mitigation projects by the NRCS/EWP/ECP.

Recommendation: There are approximately 15 low-clearance bridges passing under the north-south streets in Brigham City. These areas are known to back-up flood waters threatening homes and businesses. The city should retain a supply of sand bags for emergency mitigation purposes and have a sandbagging plan for such flood situations. Flooding is not common in Brigham City due to flood storage at Mantua Reservoir.

Recommendation: Private sector partnerships for flood mitigation could be developed between the city/county and NUCOR Steel and Parsons Construction.

Recommendation: Have a sand bag plan for sixth north, where Box Elder Creek threatens some farm buildings.

Recommendation: Identify locations where roads would be inundated if Cutler Dam were to fail. Have a warning plan in place.

Recommendation: Develop a private sector partnership for flood mitigaton with the Union Pacific Railroad. Flooding of the Bear River, Box Elder Creek, threatens railroad grades.

Recommendation: Develop private sector partnerships with Utah Power and Light for Great Salt Lake flood mitigation to protect power poles along the east side of the lake. The partnership could also be extended to any developed area along the lake.

*** Recommendation:** Construct levees around the Corinne Sewage Treatment Lagoons to protect them from flooding of the Bear River.

Recommendation: Create a private sector partnership with U.S. West to protect telephone line that cross

the rivers attached to bridges. Perhaps the partnership could be extended into adjacent cities.

CACHE COUNTY:

Cache County Flood Hazard Analysis developed by Fred May, State Hazard Mitigation Officer, Dave Buell, Cache County Liaison, and Bob Degasser, Cache County Emergency Management Director, during January 1996. The Flood Hazard Analysis Model used was developed by Fred May, State Hazard Mitigation Officer and Ken Short, P.E. Hydrologist, Utah Division of Water Resources.

Recommendation: There is some flood potential from constricting of channels at a county bridge in Nibley and the Little Bear on Mindon Road and at Clarkston Creek by the cemetery. These channels should be maintained each year, prior to snowmelt runoff. There is not much of a problem with this, but there is very little development because potential residents cannot get sewer systems in due to a high water table. It is more grassland; not cultivated. There is very little threat to commercial property, except for the Logan Golf Course. As the county grows, all of the land that has risk may have more commercial risk. Most people build on high ground. Most of the threat from these four drainages is to agricultural land. This is mainly noncultivated pasture land. There is minimal risk other than to hay barns or small animal shelters.

Recommendation: At Mendon, there is flood threat from the Hyrum Canal, an irrigation canal owned by the U.S. Bureau of Reclamation. The Kimball Decree has to do with where the valley was ringed with irrigation canals. Flood problems result because runoff catches in the canals and goes down the contours and can't get out until it finds a natural low spot. Mindon has the worst flood potential in the county, being at the end of that canal. The canal comes out at Petersborough, which has the second highest risk. North Logan and Hyde Park is ranked next. A flood hazard mitigation plan should be developed for Mendon to determine what to do. There is much new development going in at Mendon, and this is increasing flood risk.

Recommendation: The County should maintain a stockpile of sandbags to be used along the Blacksmith Fork River during flood periods.

*** Recommendation:** A permanent stream gage (real-time transmitting) should be placed above the UP&L Dam in Blacksmith Fork Canyon.

MENDON, CACHE COUNTY, UTAH:

On September 1, 1998, the following people met to begin development of a Mendon, Cache County Flood Mitigation Plan. Elmer James, Mendon Flood Control; Fred May, Utah CEM, Interagency Technical Team Coordinator (IAT), Bob DeGasser, Cache County Emergency Management; Will Atkin, P.E., Utah Division of Water Rights; Mark Beutler, U.S. Bureau of Reclamation; Paul Jones, Mendon Developer. The plan is in preparation, awaiting funding by NFIP, Flood Mitigation Assistance Planning Grants.

The main Mendon flood problem is heavy rains on top of snow-covered frozen ground in January and February; a false spring or a January thaw melts the snow but the ground does not thaw and then the area

receives a warm rain on top it and accelerates the melt and the runoff has no place to go. The canal is full of ice and flood problems occur. Flooding is tied to the Mendon Canal. The canal serves as a rain gutter for the watershed. The ultimate end of this canal problem is that it dumps out at the other end of the canal and severs Hwy 23 in Petersborough. That is kind of a secondary issue. The USBoR has fee-title for the canal from Hyuom Reservoir and Dam to Petersborough and then east to the Little Bear River (fee title except for 1.5 miles between Mendon and Hyrum Reservoir; generally 15' uphill and 35 feet downhill.

The history of flooding in Mendon begins in 1982, in the wet years, and coincided with El Nino years. There has always been minor flooding, but nothing compared to the wet years. Mendon has experienced three or four serious floods in the past 30 years, but historically there have been several from cloud bursts. The mountain was grazed heavily at the turn of the century and up into the thirties and forties. People back in 1909 remember flooding back that long ago. The Mendon Canal was constructed in 1935. The canal hasn't been modified or upgraded. Mendon proper is at risk and the flood waters go directly through town. The canal is concrete lined where the soils are permeable in a short reach,for a block or so Wellsville; otherwise the canal is all earthen.

The population of Mendon is about 950 with 240 homes (water hookups). Mendon does participate in the National Flood Insurance Program. Mendon ahs applied for FMPG of $5,000 for FY99.

Recommendations: Develop a flood mitigation plan for the town of Mendon, Cache County, Utah.

Recommendation: Obtain a concensus between environmental regulatory agencies and flood mitigation agencies that irrigation canals sometimes pose unusually high threat to life and property when, and if, they breach. This threat arises from the fact that many lie above the lay-of-the-land and when they breach they drain into adjacent areas that may be developed. Additionally, the volume of water to drain can be extensive due to the length of the canal that may be full of water. Emergency work to be done in adjacent areas may be environmentally-sensitive, but still require emergency work. Additionally, longer-term mitigation work may be required to protect life and property, especially, if there is a history of flooding from the canal.

DAVIS COUNTY:

* The **recommendations** identified in the Centerville, Davis County, Community Action Plan, for Project Impact, should be considered part of the State Hazard Mitigation Plan, as should the Centerville Flood Hazard Mitigation Plan. Those not implementatble through Project Impact, or imnplemented by the time of the next Presidential Disaster Declaration, are considered to be part of the project listing for the Utah Hazard Mitigation Grant Program.

MORGAN COUNTY:

The following flood hazard mitigation recommendations for Morgan County were determined by a Utah Interagency Technical Team Flood Vulnerability Analysis conducted on the two dates indicated below. The project recommendations are listed as potential **HMGP projects**, as identified by Morgan County Planner,

Steve Young, on March 1, 1995, and by Dennis Stuart, Roads Supervisor; Joan Mortenson, Emergency Management Director; Kent Smith, County Planner and Scott Stoddard, U.S. Army Corps of Engineers, on July 21, 1997. Also attending the latest meeting were Jean Segura and Bob Fowler, Utah Division of Comprehensive Emergency Management.

Reference: Flood Hazard Mitigation Plan for Morgan City/County, July 1992, by Nancy Barr, Utah CEM, Student Intern Project; Directed by Fred May, State Hazard Mitigation Officer.

*** Recommendation:** Several areas along East Canyon Creek should receive rip rap and debris removal.

Lead Agency: Morgan County; possibly Natural Resources Conservation Service (NRCS) following next flood.
Time Frame: Ongoing; and following next flood.
Cost: $200,000

Recommendation: Some areas along the Weber River should receive rip rap.

Lead Agency: Same as above.
Time Frame: Same as above
Cost: Same as above.

***Recommendation:** Replace Devil's Slide Bridge.

Lead Agency: Utah Department of Transportation and County.
Time Frame: Five years.
Cost: $200,000

*** Recommendation:** Place berms around the schools in Morgan. Perhaps berms should be placed around the back side of the high school.

Lead Agency: Morgan City.
Time Frame: Two years
Cost: $100,000 (Community Development Block Grant)

*** Recommendation:** Place berms around the Morgan Health Center.

Lead Agency: Morgan City and Health Care Center
Time Frame: Five years
Cost: $50,000

*** Recommendation:** Construct levees to protect older areas in Peterson. Emergency levees do exist there now; these were not engineered. Engineered levees would be an improvement. One-half mile of levee is recommended.

Lead Agency: Morgan County, Town of Peterson, and NRCS or USACE (following next flood).
Time Frame: Five years
Cost: $500,000

*** Recommendation:** Levees along the Weber River near the City of Morgan are at about a 30-year flood elevation. Levees would be helpful through Morgan. Place 100-year levees.

Lead Agency: Morgan County, Morgan City, and USACE.
Time Frame: Five years
Cost: $3 million for 16,500 feet of levees.

Recommendation: Conduct a slope stability study along Strawberry Creek. There are visual signs of cracking 100-feet back from the creek. People wish to build close to the creek. A general impact study for the area along the creek would be helpful.

Lead Agency: U.S. Army Corps of Engineers; Utah Geological Survey, and U.S. Geological Survey
Time Frame: Five years
Cost: $10,000

The following recommendations are retained from the 1992 Morgan County Flood Hazard Mitigation Plan, referenced above. For details see that plan.

Recommendation: It is recommended that Morgan City apply for CRS. Many of the activities may already be in place within the community's floodplain management objectives.

Recommendation: Elevation Certificates: FEMA Elevation Certificates must be completed and maintained on all buildings constructed or located in Special Flood Hazard Areas (SFHA). Copies must be available upon request.

Recommendation: Map Determinations: Respond and document requests for information on Flood Insurance Rate Map (FIRM) zone and flood data.

Recommendation: Outreach Projects: Advise residents about flood hazards, flood insurance and flood protection measures. This could include basement flooding, flooding from intense thunderstorms, and spring flooding and be presented in biannual newsletter sent through a public utility bill.

*** Recommendation:** Open Space Preservation: The community can set aside special flood hazard areas as public open space. The acquisition of land along the Weber River to create a parkway to benefit the tourism within the City can be explored.

Recommendation: Flood Data Maintenance: Maintain the elevation reference marks shown on the community's FIRM, or maintain same number of reference marks as found on the FIRM. This should be

verified every two years.

Recommendation: Stormwater Management: Regulate new development outside the floodplain to minimize adverse effects and also include, within an ordinance provisions that require peak runoff from new developments be no greater than the runoff from the site in its pre-development condition.

Recommendation: Drainage Systems Maintenance: Create a Drainage System Maintenance Program for inspection and debris removal for the community's channel systems. It should include the following: 1) Who is responsible for the maintenance program. 2) A description of area to be maintained. 3) Frequency of inspection. 4) What should be done when a problem is found. 5) A record keeping system of the program, and 6) An enforcement provision.

Recommendation: The city should create an intense thunderstorm hazard awareness campaign informing residents as to the potential impact as a result of these summer storms. They may include the following:

1. A brochure or informational letter could be placed in consumer utility bills informing them of effective measures to lessen the impact of such storms. This can include the likelihood of accompanying high winds, lightning and the resulting loss of electrical power.

2. Have retrofitting information available explaining methods that may be useful in protecting homes located on hillsides from sheet flow/mudflow created by these storms and the potential dangers involved in basement flooding.

3. Inform homeowners living along the Weber River about the potential threat of overbank flooding due to this type of storm. A door-to-door method may be used utilizing a service organization, such as the Boy Scouts, to pass out information on potential overbank flooding.

RICH COUNTY:

The Rich County flood vulnerability assessment was conducted on April 4, 1997, with Fred May, Utah CEM, Dan Ames, Rich County Emergency Management, and Dave Buell, Utah CEM. There appears to be generally little flood risk in Rich County as the Bear River flows primarily through rural areas with little development. Bridges tend to do well during high water. There also appears to be little threat from debris flows. Woodruff Creek flows from Woodruff Reservoir through the city of Woodruff. This creek has not flooded causing significant damage. Little Creek flows around the outside of the town of Randolph and there is little threat. There is risk to some farm houses along the Bear River.

Recommendation: Maintain an awareness of flood potential and inform residents of low-lying areas.

Recommendation: The county should maintain a stockpile of sandbags for use in low-lying areas where farm homes are at risk.

SALT LAKE COUNTY:

* The **recommendations** identified in the Salt Lake City, Salt Lake County, Community Action Plan, for Project Impact, should be considered part of the State Hazard Mitigation Plan, as should the Salt Lake Flood Hazard Mitigation Plan (being prepared). Those not implementatble through Project Impact, or imnplemented by the time of the next Presidential Disaster Declaration, are considered to be part of the project listing for the Utah Hazard Mitigation Grant Program.

SANPETE COUNTY:

The first county flood vulnerability assessment was conducted on August 8, 1997, with Fred May, Utah CEM, Barry Bradley and Dale Nicholls, Sanpete County, and Scott Stoddard, USACE. An update was prepared following the flooding of Spring City in late July 1998. Those present were Fred May, Barry Bradley, and Neal Sorenson (Spring City Council).

*** Recommendation:** Construct a debris basin at the mouth of Canal Creek Canyon to protect the historic district of Spring City.

Recommendation: Conduct a debris flow/flood potential study for the alluvial fans on both Canal Creek and Oak Creek, doing Canal Creek first.

Recommendation: The National Flood Insurance Program (NFIP) should conduct an flood insurance awareness campaign in Spring City. This effort should include the Utah Division of History and the State Historic Preservation Officer.

Recommendation: The county should retain a stockpile of sandbags for emergency flood mitigation within the county. Such places as Spring City are especially vulnerable.

Recommendation: The city of Spring City should apply for funds from the Community Impact Board and Community Development Block Grant Board for the possible construction of a debris basin at the apex of Canal Creek's alluvial fan.

Recommendation: Residents of the floodprone communities of Sanpete County should be provided with periodic flood awareness education, especially in communities downstream from canyons with known histories of slope failures.

Recommendation: During times of flood concern, canyons should be flown to determine the condition of the watersheds and if slope failures are occurring.

Recommendation: A funding source should be found, or created, to replace damaged irrigation structures that play a role in flood control.

Recommendation: Dairy farm manure bunkers located in the floodplain above Ephriam and the Snow

College Campus should be protected by levees to prevent contaminated flood waters from reaching the campus.

WEBER COUNTY:

This flood vulnerability analysis for Weber County was prepared by Fred May, Utah CEM; Ken Short, Utah Division of Water Resources; Jeff Malan, Weber County Emergency Management Director; and Curtis Christensen, Weber County Engineer. This plan was first developed in March 1995 and then updated on June 10, 1997.

There is widespread flood threat across many watersheds or basins in Weber County. As for mudslides, there are concerns from the mouth of Weber Canyon to Riverdale. Mud slides can affect railroad, some utility lines, and storm drainage lines. Some development threatened on the uphill side. Several locations. The area is unstable for about one mile. There have been several slides.

As for flood potential from high water flows, from the mouth of Weber Canyon, there is Hwy 89 and the bridge crossings that have a high damage potential from erosion taking out the footings. There are homes in the area which can be endangered because of erosion and subsequent flooding. Mountain Fuel Supply gas lines cross the river at about 2000 E next to Uinta town; at end of Buena Vista Drive. Farther down there are sewer line crossings in Riverdale and again into Ogden City. We have problems with erosion into the railroad. Endangering of homes through Riverdale. They haven't flooded yet, but there is concern. They were protected in 1983 and the dikes are still there. There is Hwy 84 that received damage in 1983 and 1986 and it is still susceptible through Riverdale and Uintah Town area. Into Ogden, there is erosion into the Weber County Landfill and the Fort Buena Ventura State Park. Downstream farther, there are the railroad properties and hazardous materials sites. Then to the confluence.

From the confluence of the Ogden and Weber Rivers, on out to the lake, there is erosion of agricultural type lands and potential of flooding homes in the Warren area. There are tree snags on the bridges associated with high velocities. There is the erosion of the banks and berms that allows flooding of adjacent properties in the Warren area. Mostly here, there is the potential for agricultural losses. There is possible damage to agricultural pump sites (irrigation pumps).

* **Recommendation:** Protect river banks from erosion by starting new growth by planting river bank vegetation.

The main need is to find ways to control and stablilize the banks, both through the cities and out west. General mitigation approaches are needed for both residential areas and for those with agricultural uses. The county has wondered why more willows do not grow along the river (small river willows).

Encourage the use of a buffer between the farmland/crop area and the river to allow the new vegetation to grow and to not distrub old vegetation. The idea is to encourage the growth of river bank vegetation.

Recommendation: There is a need to remove trees and debris blocking bridges. Obtain access along the river to remove trees. Clean under bridges.

Recommendation: Through the town of Uintah, there are homes and mobile homes that were flooded (shallow flooding) in 1983 and 1986. Out west, there were homes flooded from overtopping in the Warren area. Restrict building in the future or put additional conditions on building. For the existing homes, do berming and bank protection.

Recommendation: The Railroad is commercial property. There are two types of damage taking place there. There is erosion and softening of the base and potential damage from flooding of hazardous material sites. In the Riverside Industrial Park there has been minor flooding of commercial properties. Bank stabilization and berming are required for both the railroad and the industrial park.

Recommendation: Sewer and water lines both cross and run parallel to the river. These should be protected from erosion prior to major future flooding. There is potential for erosion into these utilities. Sewer and water lines pass through Riverdale. Ogden City has lines that cross the river at the Old Coliseum area. There are sewer lines crossing at 1900 West. There are irrigation structures at the Willard Canal Diversion at 1200 West and 1700 South. There is another canal diversion at 1900 West and about 1200 South. There is a canal diversion in Plain City area at about 4000 West and about 1500 North. Through the coliseum area, power lines have been threatened. Natural gas lines in Uinta have been threatened. Where lines cross or run parallel to the river, the county has already established concrete barriers or structures immediately downstream to prevent headcutting. They have bermed and provided bank protection upstream from the sites to keep water in the channels to prevent erosion. There may not be much more to do. For power lines, it is suggested that the power poles be relocated away from the river.

Recommendation: As for undermining of bridge foundations, Problem areas are at the mouth of the canyon at I 84, undermining occurred. Repairs and mitigation measures taken were installing pilings downstream to prevent headcutting. Other locations downstream require providing continual maintenance to remove snags under the bridges. The bridges seem to be high enough. The center supports catch debris. Debris is simply removed. Mitigation involves ongoing maintenance.

Recommendation: There have been some road inundations. These resulted in a failure of the road surface. At one location, the county did have the potential of isolating businesses on 1900 West and about 1300 South near Hwy 89. Roads were inundated out west in the Warren area. One road was closed because it washed out. The road was cut with a backhoe to relieve flooding. The water was going over it before. The flooding damaged the road surface (asphalt and base). This did not isolate anyone and posed no threat to people. Mitigation includes providing bank protection for the river in the form of vegetation and some isolated cases of berming or levees.

DROUGHT HAZARD

The following set of recommendations resulted from the development of the San Juan County Drought Hazard Mitigation Plan, specifically from the Hazard Mitigation Planning Workshop conducted in Monticello, San Juan County, on September 10, 1996. These are applicable for drought-prone counties statewide and should be considered for implementation.

The term "issue" refers to a general need to be addressed for mitigation planning. For example, "renewable resource management" is an issue when considering animal forage during drought periods. Public grazing lands can be damaged by overgrazing, especially during drought periods, and lands designated for both wildlife and livestock forage must be managed in such as way that the forage is renewable.

This Section of the plan contains 25 recommendations identified at the San Juan County Drought Committee Meeting of September 10, 1996 and at the Western Governor's Association Drought Task Force Meeting Austin, Texas, on September 5-6, 1996, which San Juan County officials attended. These issues and recommendations are generally applicable statewide. **NOTE:** Several other issues and recommendations were identified during the comprehensive interview process conducted with those individuals listed at the beginning of this chapter.

Note: The San Juan County Drought Hazard Mitigation Plan contains many recommendations gathered through extensive interviews throughout the county, including the Navajo and Ute Chapters. The general nature of those recommendations should be applied statewide and be part of this State Hazard Mitigation Plan.

Issues Identified by San Juan County Drought Committee (Applicable Statewide):

Note: Agencies provided in brackets would be considered lead agencies to address the recommendation.

Note: In some cases implementation strategies have been discussed during the course of drought mitigation planning interviews. Not all issues and recommendations developed at the Planning Workshop were discussed in terms of implementation strategies. These are highlighted below.

1) Cloud Seeding: Reservoirs in the county are at about half of average volume for this time of year. Cloud seeding may enhance seasonal precipitation and runoff into these reservoirs by as much as 15 percent. The county is in need of more information about cloud seeding, its effectiveness, scheduling, contracting, and cost. (County Issue).

Recommendation: Implement cloud-seeding during drought years to enhance precipitation.

2) CRP Extension: (Farm Services Agency Issue; Private Land Owners)

Note: This became a non-issue when the CRP was extended, as requested. However, in drought years when curtailment of CRP seems likely, consideration should be given for extension.

3) Livestock Water and Forage: There is a shortage of water and forage for livestock. The need is to bring more water and forage to the livestock, or to bring the livestock to water. (Natural Resources Conservation Service Issue)

3a) Water and Forage on Government Lands: There is a need for a greater supply of water and forage on government lands and for a program in range development. (sub-issue; Livestock Association)

Recommendation: Drill more shallow wells to water cattle on government lands.
Recommendation: Include water resource in range management on government lands.

3b) Renewable Resource Management: Renewable resources affected by drought should be identified and managed (both used and protected, in balance) so that they are available for future years. There is the potential for damaging these resources during a drought through unwise management practices, such as over-use. Natural resources should also be protected. (U.S. Bureau of Land Management; U.S. Forest Service).

Recommendation: Identify renewable resources affected by drought should be identified and managed by the appropriate government agency.

3c) Resource Development: There is a need to develop renewable resources so that, during drought years there would be more resources available for use. This practice is analogous to developing more wells, ponds, and reservoirs, so that more water will be available. In this case, we are considering primarily forage and water for wildlife and livestock, but the concept also applies to water development projects because water is also a renewable resource. (U.S. Bureau of Land Management).

Recommendation: Develop government grazing lands programs that address developing renewable resources.

3d) Multi-Use of Public Lands and Forests: During non-drought periods, public lands and forests have multiple uses. During drought periods, there is a need to modify the balances of use. For example, cattle grazing may require special considerations that may also affect deer and elk herds and ultimate deer and elk hunts. During drought years, hikers and campers may also be affected through campfire restrictions due the increased wildfire threat. (U.S. Forest Service).

4) Low Interest Loans: Farmers and ranchers can generally not afford the expense of growing crops and maintaining livestock herds during a drought period because the price of beef is low, the cost of feed is high, and the cost of hauling water is high. The need is for both short and long-term low interest

loans. (Soil Conservation Districts).

Note: This is a difficult recommendation because lenders should anticipate repayment. Still, in an extended drought, repayment may not be possible.

Recommendation: Create a national drought assistance fund developed through payments through annual participating farmers and ranchers. These funds could be used as collateral for low interest loans, in the event the loans cannot be repaid due to ongoing drought. There should be a limit of three years until repayment begins.

5) Uninterrupted Culinary Supply: There is concern that culinary water supplies for the various cities will be severely impacted during Water Year Two of the drought (October 1, 1996 - September 30, 1997). The need is to protect culinary water systems and/or to provide culinary water to those systems or people if the drought continues. (City Engineers)

Note: The drought did end after one year and culinary water sources/resources were not affected in the county. However, this is still an issue for a future multi-year drought.

Recommendation: Methods of providing emergency, or back-up, culinary water to impacted residents should be determined. It is likely that in an emergency response situation that methods would be found to provide water.

6) Drought Mitigation and Management Plan: Drought hazard mitigation includes identifying threats to people and local governments that result in unacceptable impacts that may happen affecting the overall welfare of a community or area in terms of economy, public health, welfare, or safety. Drought disaster management (response) includes identifying and taking actions to impede impacts in progress. Mitigation and preparedness work hand-in-hand, in that what threats are not mitigated can still be experienced as impacts in the drought disaster. A Drought Hazard Mitigation Plan must attempt to determine what threats and impacts are mitigated and which are not, so that preparedness measures can also be identified. Thus, hazard mitigation/preparedness plans are prepared in a pre-event time frame (in this case, for what may happen next spring and summer and in future years) and drought response plans involve responding to the drought impacts, as they happen. This suggests the need for two kinds of plans, a County Drought Hazard Mitigation Plan and a Drought Management/Response Plan. Together, both plans provide the means for the county and cities to lessen impacts in a drought. (San Juan County; San Juan Water Conservancy District; and City Engineer, Blanding, San Juan County, Utah).

> **6a. Drought Hazard Mitigation Plan:** This present plan is the County Drought Hazard Mitigation Plan, prepared by the State Hazard Mitigation Planner (Interagency Technical Team Coordinator). This plan will serve as the basis for a multi-county plan, which is the Drought Annex for the State Hazard Mitigation Plan.
>
> **Recommendation:** Develop a County Drought Hazard Mitigation Plan. This would be the first

such plan in the U.S.

6b. Drought Management Plan: The county would prepare a County Drought Management Plan to identify response measures to be implemented during a drought.

Recommendation: The State prepared a Statewide Drought Management Plan which is being managed by Utah CEM. Still, there is a need for a county drought management plan to conduct operations at the local level. This is not a mitigation activity and should be treated separately.

7) Drought Resource Coordination: There is a need for a central source of drought resource coordination, so that all available resource programs are systematically brought-to-bear on drought threats and impacts, especially as they are needed. this requires many people working together relative to the overall array of impacts. (San Juan Water Conservation District).

Recommendation: Create a County Drought Hazard Mitigation Team to coordinate and organize resources for the mitigation of drought threats. This Team could identify potential needed resources and create partnerships that could assist with development of mitigation measures to reduce or eliminate impacts from future droughts.

8) Water Resources/Development: There is a need for more water resources in terms of wells, ponds, reservoirs, and reservoir capacity. (Utah Division of Water Rights; Private Land Owners)

Recommendation: Investigate the possibility of more water resources within the county. New water technologies could be researched and applied, where possible.

9) Wildlife Management: There is a need to manage wildlife during drought periods so that livestock can find adequate forage (and perhaps water) on government and private grazing areas. There is competition for forage by deer and elk herds with the livestock because all compete for the same food. (Private Land Owners)

Recommendation: The objectives for elk herd-size should not be exceeded, and the traditional numbers of grazing units/permits should be maintained. During drought years, when grazing permits are reduced, these permits should be restored, and a balance between a suitable number of elk and cattle should be maintained following drought years.

9a) Public Lands Wildlife Habitat Improvement: Habitat improvement for deer and elk can also benefit livestock. There is a need to enhance the habitats for both. Funding programs for habitat can also assist livestock. (Utah Division of Wildlife Resources)

Recommendation: joint-use improvements should be provided by both cattlemen and wildlife management, so that all can benefit equitably.

9b) Private Lands Wildlife Habitat Improvement: Same as above. (Utah Division of

Wildlife Resources)

Recommendation: Recommendation is similar to above.

10) Wildfire Planning: There is a need for wildfire hazard mitigation planning, as well as for wildfire response pre-planning. (County Fire Marshall)

Recommendation: The County Fire Marshall should prepare a county wildfire hazard mitigation plan. An excellent mitigation tool is awareness of prudent mitigation practices in the Urban Wildland Interface. The Urwin and Wufi Children's wildfire education program should continue. A county building code could address URWIN home building practices.

11) Private Assistance: There may be a need for financial assistance to low income people during droughts, or for people who experience low income during a drought. This could involve financial assistance, food banks, and housing. (Southeast Association of Governments)

Note: This is difficult to implement due to potential abuse by some. Still the need exists for those truly impacted.

Recommendation: A national drought fund should be created by willing participants who could provide monthly premiums to create the fund. During drought years, when the need arises, wherever in the nation, and criteria are met by impacted individuals, the drought fund could help support them until the drought is over.

12) Transportation of Livestock: The transportation of livestock for forage and watering is expensive and cattle ranchers may not be able to afford the expense. There is a need for financial assistance to area ranchers to transport cattle.

Recommendation: Congress is presently examining the need for a National Drought Policy Act which would address drought disaster assistance. This type of impact would appear to be a typical need to be considered by congress. It is recommended that Congress include this need in their considerations.

13) Water Hauling for Livestock: The transportation of water to livestock is expensive and ranchers may not be able to afford the expense. There is a need for financial assistance to area ranchers to transport water to the livestock.

Recommendation: See recommendation, above.

14) Public Information: There is a need for public information about the drought and its affects. The various affected groups (irrigation water users; culinary water users; ranchers, etc.) need sources of drought information to help them to understand the threats and impacts, as they relate to them.

Recommendation: It is recommended that links be established with the National Drought Mitigation

Center that would provide the needed information to impacted areas. At present, the NDMC is on the internet with considerable information. The NDMC does monitor drought and present information on effects, mitigation, preparedness, and response. The NDMC also addresses timely issues.

15) Identification of Grant Sources: There may be more sources of grants for drought mitigation and response than the County Drought Committee is aware of. These sources should be identified and considered for use within the county.

Recommendation: At this stage of hazard mitigation planning, and considering all of the people involved, including the National Drought Mitigation Center, it is unlikely that grant sources are being overlooked. Still grant sources could be created. The creation of grant sources should be considered as part of the National Drought Policy Act being considered by Congress. Additionally, a national fund could be created by willing participants who could donate to it on a monthly or annual basis.

15a) Agriculture Fund Available: The Utah State University Agriculture Extension Agent for San Juan County is aware of a fund ($22,000) that can be used (cost-shared) for a variety of kinds of drought-related projects. There is a need to consider how to use this fund and cost-sharing sources. (San Juan County Commission)

Recommendation: The County Extension Agents statewide should represent the their counties in obtaining this fund for use during drought.

16) Identification of Cost-Sharing Sources: The San Juan County Drought Committee identified at least one source for cost-sharing (Natural Resources Conservation Service). This is of interest statewide. There is a need to conduct a broad-survey among the Federal, State and local government agencies involved with the drought to identify other sources. (San Juan county Commision)

Recommendation: City and County organizations, representing drought -prone areas of the state, should develop and maintain a listing of matching-fund sources for use during drought periods. These organizations should make these sources known and conduct training for potential applicants.

NOTE: The San Juan County Drought Hazard Mitigation Plan is based on numerous interviews with cities, towns, and the Native American Chapters This Plan is under development, will will be added as an Appendix to this present State Hazard Mitigation by in December, 1998.

Great Salt Lake Hazard Mitigation

HAZARD MITIGATION RECOMMENDATIONS

GREAT SALT LAKE
BENEFICIAL DEVELOPMENT AREA
(BDA)

This plan retains the concept of the Great Salt Lake Beneficial Development Area (BDA) as developed for the Utah Hazard Mitigation Plan - 1985. Some of this text is presented for review because it is an excellent compendium of Great Salt Lake hazards history and because many people may no longer have their copies of the Utah Hazard Mitigation Plan - 1985, where that information is contained. It is recommended that the Great Salt Lake Beneficial Development Area (BDA) be retained as a guiding factor for lakeshore development. It is restated as follows:

Establish a Great Salt Lake "Beneficial Development Area" (BDA): Synopsis: Using the best historical and scientific data on the Great Salt Lake, a consensus is being arrived at among policymakers and other lake experts that a beneficial development strategy should exist for lake shore areas up to 4217 feet, a documented shoreline fluctuation surface. A coordinated effort between local and state agencies, with the ultimate goal of developing lake shores to the best advantage of the people of Utah, will also have the effect of minimizing what has been to date astronomical lake flood losses.

Introduction to the BDA Concept:

The Beneficial Development Area (BDA) is an attractive alternative to the various levels of government paying $200 million to a possible $2 billion during lake-flooding episodes, while at the same time funding other associated wet-cycle multihazard disasters: debris flows, riverine floods, and landslides. If the lake were to rise to levels recorded as recently as the 1600s, such costs could cripple the economy of the state, both locally and statewide. The recent lake rise of five feet per year for the past two year's wet-climate cycle was unusual but by no means uncharacteristic, and will almost certainly happen again, perhaps to a higher level. Oddly enough, positive aspects could prevail during wetclimate cycles in Utah. Grazing and forest lands fluorish, hydroelectric potential is enhanced, summers are cooler and winter skiing is better.

The BDA is an opportunity resulting from the past two year's astronomical flood expenses (about $200 million). The concept depends only on a joint agreement that the counties, cities, and the state wish to develop the shorelines of the Great Salt Lake in all aspects to the best advantage of the people of Utah, while avoiding nature's persistant effort to deplete local and state funds. An intercounty-citytown organization will be chosen and will meet, as needed, with representatives of state agencies to plan the beneficial development of the Great Salt Lake.

The “BDA" encompasses an area around the lake within which known key lake levels have been reached in the near past and can be documented: 4191.4 feet (historic lowstand, 1963), 4211.5 feet (historic highstand, 1873), 4214.9 feet (spillover point into West Desert), and 4217 feet (lake terrace created during 1600s, based on archeology). The upper BDA level may havc been reached as many as five times during the past 500 years. Thus, the BDA is a documented lake fluctuation surface which if developed properly could save the citizens of Utah billions of dollars, while yet achieving desirable development goals.

Recommendations For Establishment of the Great Salt Lake "Beneficial Development Area":

Recommendation: Local governments should take the lead by organizing an Intergovernmental Great Salt Lake Beneficial Development Council (IBDC), including selected state officials, and coordinate efforts to determine the most advantageous development for the Beneficial Development Area (BDA) which extends landward to the elevation of 4217 feet, encompassing the documented lake-fluctuation surface (should the lake ever reach that level, wind waves will likely increase the fluctuation surface yet farther). The IBDC should define its objectives to include developing the Great Salt Lake BDA to maximum prudent use while avoiding astronomical flood losses, and to avoid unfair decisions against development already within the BDA.

The Logic of Establishing a "Beneficial Development Area" (BDA):

Although logic seems to dictate that the lake level will now go down, logic did not dictate that the lake would go up. The probabilities of the lake rising as it has over the past three years were remote at best. When the surprising rise did contradict the predictions, it caused an estimated $200 million in damage plus more for lost tax revenues. Should the lake continue to surprise us by rising to 4212 feet, the cost is estimated at $269 million. Because the concensus is that: lake studies need to precede a thoughtful approach to developing lake shores, it makes sense to establish 4217 feet as a Beneficial Development Area within which we will apply what we have learned. Interviews conducted during the development of this plan continually indicate the need for basic studies. These studies should be done relative to 4217 feet. Although no official floodplain of the lake has ever been set, it seems clear that developing below 4217 feet could, at some point, mean trouble - if not from actual saltwater damage, then from high ground water problems, poor drainage and other problems.

If the Great Salt Lake again hits 4217 feet it would flow into the West Desert (4214.85 feet), expanding its water surface by 40 percent. The new shallow lake would extend west to Wendover. The larger surface area may well increase the so-called "lake effect." Eastward moving weather fronts sometimes pound the Salt Lake Valley harder than expected. Meteorologists believe the clouds pick up moisture over the Great Salt Lake. The heavy clouds move up against the Wasatch Mountains and drop the evaporated lake water. The greater the lake's surface area, the greater the "lake effect," some scientists believe.

Thus, the larger the lake, the more it may feed itself through Wasatch Front precipitation - a cycle that could keep the lake at about 4217 feet for years until a long dry spell could break the effect and drop the

lake to lower elevations.

Given this scenario, we are recommending that thought be given to the potential of the lake again reaching 4217 feet (either directly or from wind/storm waves and tides), the impact if it does, and what should be done regarding the beneficial development up to this level. Ultimately, through the joints consensus will result to proceed ahead with beneficial development within the BDA.

Recommendations From The Great Salt Lake Conference On Problems Of and Prospects For Predicting Great Salt Lake Levels

The information provided below is also provided for review from the Utah State Hazard Mitigation Plan - 1985. Much of that section is considered relevant today.

Results of the Great Salt Lake Conference on Problems of and Prospects for Predicting Great Salt Lake Levels:

On March 26-28, 1985, a Great Salt Lake Conference was conducted in Salt Lake City to determine what is known about recent Great Salt Lake levels and predictability on future levels. Experts on Great Basin climatology, hydrology, and geology presented their research in the hope of arriving at conclusions regarding the future of the lake. A summary of their recommendations is contained in this section.

A special session of the Great Salt Lake Conference was set aside at the end to determine the need for future studies and, in particular, to define the "planning" level for the Great Salt Lake. Five alternatives for the planning level had been discussed in previous sessions. These levels (all given in feet) were: a level below 4212, 4212, 42174218 (the threshold level), 4222, and a level above 4222. A "planning level" is the level above which the participants would not expect the lake to rise during the foreseeable lifetime of Salt Lake City. The "planning level" does not imply that the lake will rise to that level, simply that the possibility that it could rise to that level is significant enough that decisionmakers should factor it into their planning process. Much consideration was given to each level. Most participants believed 4217-4218 feet is a "rational number to work with." Judith McKenzie (Florida State University) indicated that her data show that during the past 500 years this level has been reached perhaps as many as five times and certainly a couple of times. Many of the specific research topics suggested that further research would directly contribute to the better understanding of the 4217-4218 foot threshold and its consequences to society.

Although consensus has been reached on the "planning level" of the Great Salt Lake, there was obvious concern about the certainty with which past lake levels had been picked. Several recommendations resulted from this conference which would greatly enhance the understanding of frequency and duration of lake levels in the recent past.

Selected Recommendations Resulting From the Great Salt Lake Conference:

1. Conduct socioeconomic studies to determine the consequences to society of different levels of the Great Salt Lake.

2. Cores should be taken in the deeper areas of the West Desert Basin and analyzed geochemically and by sedimentological means to ascertain the frequency with which the West Desert has been occupied by water. Participants felt that geochemical examination of the core could distinguish times when the West Desert Basin and Great Salt Lake Basin were united as a single lake.

3. Sediments in the boggy areas along the edge of the playa lake could be analyzed for changes in organic constituents due to flooding of the West Desert.

4. Additional core could be taken in the Great Salt Lake Basin and analyzed for its geochemistry. Some of this work has already been done and has been a successful way to note changes in water level as reflected by salinity and carbonate deposition.

5. Further delineations of shorelines, particularly the lower most shorelines, and the application of archeological findings to these shorelines has given some indication of flooded conditions in the past and appear to be a productive way to further delineate levels of the lake in the past 5000 years. Unlike geochemical analyses of cores, these studies provide information about the actual dates of flooding.

6. One of the most obviously needed pieces of information is the actual threshold level and detailed information concerning the basin morphology. The basin's geometry changes considerably at intervals between the levels of 4215 and 4225 feet and this will effect evaporation. This is an important piece of information when determining the potential for the lake to stabilize as precipitation and evaporation reach equilibrium. Most participants at the conference were surprised at the difficulty in determining the volume of the lake and correlating the volume of water with the lake level. Understanding the topography of the region would greatly assist in these volume calculations but it is also necessary to further consider rebound effects. All participants agreed that a detailed geodetic survey is a very high priority.

7. Virtually all participants agreed that tree ring research is one area for further study. No tree ring studies have been done in the Great Basin to correlate climate with the level of the Great Salt Lake. Tree ring studies done outside the Great Basin area have been more reliable in documenting dry periods than wet periods. It was suggested that trees known to be good indicators of wetter periods located in the Great Basin itself be selected for tree ring studies.

8. The short-term consequences of structural hazard mitigation that have been suggested should be further defined. The potential for catastrophic failure due to a malfunction of a dike or the probability of liquefaction from even a moderate earthquake should be considered.

9. Certain economic thresholds might be defined for policymakers as well as lake thresholds in order to better define the consequences of lake levels.

10. It was also suggested that the levels of other lakes in the Great Basin area be examined to see whether a pattern exists in the regional rise and fall of lakes. Some participants cautioned that these studies could lead to false correlations and it was urged that the physical factors controlling these levels be identified and compared, as well as the history of the levels of these lakes.

406 Plan Recommendations: For The Great Salt Lake

Utah CEM endorses those recommendations cited above from the results of the Great Salt Lake Conference. The recommendations listed below have resulted from separate lines of inquiry, but tend to support those from the conference.

1. Designate a "Beneficial Development Area (BDA) around the lakeshore up to an elevation of 4217 feet, based on the near recent highstand of 4217 feet (based on archeology). Within this "BDA," encourage maximum prudent development of the lakeshore area while avoiding the astronomical expense from flooding. In addition to the recommendations for the "BDA" discussed earlier in this section, do the following:

2. Conduct studies on unanswered questions relating to flood hazard mitigation. Many of the Great Salt Lake Conference on Problems of and Prospects for Predicting Great Salt Lake Levels participants expressed the need for specific as well more general types of information. The State's Legislative Committee for Energy and Natural Resources also requested specific and general types of information at their April 17, 1985 meeting.

3. Investigate and stimulate the State's interests in recreational, tourism, and green belt development around the shores of the lake as part of the State's plan for developing the lakeshore areas.

4. Examine geologic and archeologic evidence that could be collected to better understand the last 100 to 5000 years using shoreline information, geochemical information from cores, and volume calculations.

5. Obtain better information on climatic factors such as tree ring studies and continued development of models.

6. Study the impact of extreme weather, ice jams, and earthquakes on earthen dikes planned for the Great Salt Lake.

7. Investigate the possibility of utilizing portable pumps in the West Desert Pumping Plan. Such pumps would have been valuable during the Thistle Lake Disaster, and may be valuable in other situations within, and outside the State.

8. Investigate the effects on transportation routes and the impact on the associated need for transportation of the various materials passing through Utah.

9. Investigate known climate patterns existing in the RockyMountain Region as they relate to lake levels.

10. Investigate what climate scenario would have to exist to cause the lake to rise to the various marker elevations, including 4217 feet. For example, how much rainfall and/or snowfall would be needed over various time intervals to cause the lake to rise to these levels.

11. Look for relict vegetation, even dead trees, that indicate wet climatic cycles that occurred prior to man's weather record keeping in the Great Basin.

12. Install real-time monitoring gages that transmit stream flow data via satellite. Real time data is valuable, once you can get it.

HAZARD MITIGATION RECOMMENDATIONS

RETAINED FROM UTAH HAZARD MITIGATION PLAN - 1985

The following hazard mitigation were selected from the Utah Hazard Mitigation Plan -1985. Several of these require ongoing implementation, and have been implemented at times. They still appear relevant beyond this present decade. In this new Plan, these recommendations are being renewed as part of State Hazard Mitigation Planning into the next decade.

High Priority:

Background: After a Presidentially Declared Disaster, FEMA requires the state involved to prepare a State **Hazard** Mitigation Plan, outlining existing hazard mitigation measures and recommendations to improve the state's hazard mitigation capabilities. Then, it becomes necessary for the state to implement the recommendations contained in the plan in order to qualify for future federal disaster funding. Such a policy could be carried out between the state and local governments, where the state would require local governments to prepare hazard mitigation plans after state, or federally declared disasters. For local goverinnents to receive future disaster funds from the state, the local governments would have to demonstrate their intent in implementing the recommendations from their plans.

> **Recommendation:** After state disaster declarations for counties, require those counties accepting state disaster funds to prepare and implement a hazard mitigation plan for their jurisdiction. Future state disaster funding for those counties may depend on their implementation of their hazard mitigation plan. The local governments should enter into an agreement with the Governor prior to being given disaster funds indicating that they will implement this plan.

Time Frame: Ongoing.

Lead Agency:
CEM Activity:

Short Term: Communicate the details of this recommendation to the Governor's Office, and ask for an Executive Order specifying the new requirements for receiving State Disaster funds and the nature of State-LocaI Government required prior to receiving state disaster funds.

Long Term: Maintain this policy within the State, refining it as experience dictates.

Cost: None

Background: Hazard mitigation efforts over the past few years have created a growing awareness that state government buildings sometimes are constructed in hazardous areas. Scientific studies conducted within the state over the past several years are illustrating the nature and locations of these hazards in most counties. Even though science cannot predict that natural hazards may indeed create a problem within a particular time frame of a few years, still science has documented the physical processes involved and that such hazards typically do create damage and injury when they do become active. With an abundance of scientific expertise on such hazards within, and available to, state government, it should become a matter of course that state building sites receive natural hazard investigation before construction is approved.

Recommendation: A State Executive Order shall be passed indicating that each state agency shall avoid the siting of state facilities, or facilities funded in whole or in part by state monies, and the administration of any grant or loan programs, for the construction of any facility in a 100-year floodplain as delineated on Federal Emergency Management Agency Maps or other "best available" data. If the state has no alternative but to build in a hazardous area, then the building should be made as structurally sound as possible to minimize damage should a disaster occur.

Time Frame: One year.

Lead Agency:
UGMS/CEM/Facilities Construction and Management **Activity:**

Short Term: Conduct a meeting involving the heads of state agencies to discuss their interests in building their facilities in safe environments. If a consensus exists, or even a partial concensus, work from that position toward obtaining an executive order requiring that state buildings not be constructed on sites with identified natural hazards. An engineering geologist should be hired by the UGMS or Facilities Construction and Management to provide building site inspections. If state buildings must be built in hazardous areas, they should be constructed so as to minimize damage and injury that might result from the existing hazard.

Long Term: The state should have the objective of ultimately owning no buildings existing on sites

with known natural hazards that might damage the structure or injure its inhabitants.

Cost: Primary cost would be the salary and overhead for the Engineering Geologist, estimated at $50,000 per Year.

Background: Although Utah has the potential for several kinds of major disasters requiring sophisticated coordination of disaster activities, the State has not approved construction of a hardened facility located close to the Governor's Office. The Federal Emergency Management Agency approved supplemental funds to assist with constructing a hardened Utah Emergency Operations Center. Their concerns are that Utah could not adequately coordinate a response effort during a major disaster. FEMA also indicates that the Utah facility is one of the least adequate in the entire United States, even though Utah has one of the highest potentials for major disasters. Utah's current EOC, located in the basaement of the National Guard Facility on Sunnyside Avenue would not survive a major earthquake.

Hazard mitigation and disaster recovery has progressed into an era of sophistication that has little bearing on old concepts of "Civil Defense". The Utah Division of Comprehensive Emergency Management is involved with a broad spectrum of natural hazards and technological hazards, including hazardous materials spills and energy shortage scenarios involving complex energy systems. The organization has the capability of communicating with the world during disasters, while at the same time is plugged deeply into each state agency that works with hazards and disasters.

Recommendation: Construct a hardened State Emergency Operations Center in close proximity to the Governor's Office to function as a communications and coordinating center during major disasters.

Time Frame: Three years.

Lead Agency:
CEM Facilities Construction and Management **Activity:**

Short Term: The initial documents requesting the State EOC facility have already passed through appropriate channels, and now require approval for funding. The directors of state agencies involved in hazard mitigation and disaster recovery should express their concern that Utah does not have a coordinating center for disasters, even though our surrounding states do. The legislature should be approached again by CEM, Facilities Construction and Management, and by the Governor to approve funds for construction of the facility.

Long Term: Utilize the State Emergency Operations Center in conjunction with all local, state, and federal agencies involved in hazard mitigation and disaster recovery, as needed. Train these staffs in the utilization of the facility.

Cost:

$4 million

Background: Although natural hazards have had much attention during the past few years in Utah, government personnel at all levels have lacked uniformity in understanding hazards and techniques in mitigating these hazards. This general lack of expertise among government employees sometimes makes communication difficult and, perhaps, causes some important figures to shy away from dealing with hazard mitigation. A basic educational hazard mitigation manual would serve as an excellent means to help government employees understand how to deal with hazards.

Recommendation: Develop a State Hazard Mitigation Manual that describes:

a. Natural hazards, including terminology.

b. Mitigation techniques for each kinds of hazard.
c. Typical costs for the various mitigation techniques.

d. Identification of hazards and signs of problems.
e. How to coordinate efforts in mitigating hazards.

f. Formation of State Hazard Mitigation Team.

This handbook, once written, would be distributed widely in the state among persons working with hazard mitigation. It would serve as a text book for instruction of these people and ultimately establish a degree of uniformity in mitigation capabilities.

Time Frame: One year.

Lead Agency: CEM

Activities:

Short Term: Delegate responsibilities for writing the text among members of the CEM Hazard Mitigation Section. Establish an outline and a preliminary table of contents. Set approximate deadlines for chapters. Complete a first draft by September 1985. Complete final draft by June 1986.

Long Term: Set up training schedules for local and state government personnel who deal with hazard mitigation. Continue to use the handbook for training purposes. Update handbook as needed.

Cost:
Other than salary expense, the anticipated expense could be as high as $25,000.

Recommendation: The counties and cities should take an active part in performing preventive hazard mitigation on high priority hazards. Each year a budget item should be passed by local governments to mitigate at least some of these hazards before they cause disasters. The UGMS should identify and prioritize these hazards for the counties, cities, and state. The UGMS should also be a lead agency in devising nonstructural approaches to preventive hazard mitigation.

Time Frame: Ongoing.

Lead Agency:
City and County EOCs
CEM
UGMS

Activity:

Short-Term: Conduct a Wasatch Front Intercounty Natural Hazards Workshop conducted by CEM and UGMS to discuss the high-priority natural hazards in the separate counties. Discuss ideas on hazard mitigation techniques and estimated costs for preventive mitigation. Write up a summary of the determinations and relay this summary to the county commissioners and city officials. Request a response on a commitment to perform preventive hazard mitigation on these items. The same can be done for other counties of the state.

Long Term: Cities and counties should gear planning and development so that preventive hazard mitigation needs diminish. Communication and activity on natural hazards within local govermncnt jurisdictions should be a routine activity. Local governments should conduct their own preventive hazard mitigation workshops, inviting UGMS and CEM; counties can utilize their county geologists to arrange the agenda.

Cost:

Preventive hazard mitigation should cost ten percent of the previous year's disaster expense for each city and county. The cost of workshops is negligible.

Flood Mitigation:

River Channel and Bank Maintenance:

Background: During wet years, the same rivers typically create flood problems. Flood problems, in many cases, can be mitigated by dredging and river bank and channel cleaning. These routine activities can protect populated, industrial and agricultural areas to a great extent. Yet, difficulties sometimes arise for the localgovemments to adequately fund these basic mitigation needs. The repetitive nature of flooding along many of these rivers and the associated expense should be a reminder of the need to maintain river

channels.

Recommendation: Local governments need to maintain at least minimal hazard mitigation responsibilities and provide funding for these activities: dredging, river bank and channel cleaning, and river bank maintenance.

Time Frame: Ongoing.

Lead Agency:

City and County Governments Water Resources

Activities:

Short Term: The Water Resources Manager should prepare a study on a county by county basis indicating the recent history of river channel maintenance and flooding. The report should be passed on to the county commissioners requesting that ample consideration be given to basic hazard mitigation needs, such as river channel maintenance.

Long Term: The counties should establish policies on basic hazard mitigation responsibilities and how these policies should be carried out; funding basic hazard mitigation needs should be a permanent aspect of local government budgets.

Cost: Expense of river channel maintenance will depend on the county.

Background: Problem drainages are often owned by various government agencies. Thus, when flooding begins, upstream controls, or considerations may involve different work staffs and different flood control philosophies or approaches. The immediate needs for coordination may be awkward if previous coordinated planning has not taken place.

Recommendation: Where different jurisdictions maintain different sections of a problem drainage, a close working relationship needs to be established between these jurisdictions by having pre-flood (late winter - early springtime) planning sessions.

Time Frame: Ongoing.

Lead Agency: CEM

Activities:

Short Term: Comprehensive Emergency Management should contact appropriate officials in the various jurisdictions and encourage them to hold preflood planning meetings. If necessary, CEM

may plan and conduct these meetings.

Long Term: Such planning meetings should become yearly events.

Cost: None

Debris Basin and Outflow Works Construction and Maintenance:

Background: A 1983 study by the U.S. Geological Survey (Wieczorek, *et al.)* indicates which canyons have the potential for debris flows and debris floods along the Wasatch Front from Salt Lake City to Willard, Utah. Debris basins are being built at the mouths of some of these canyons, as well as farther north and south of the study area. However, many canyons do not have debris basins implemented nor planned. The presence of alluvial fans at the mouths of many of these canyons suggests a history of flooding and debris flow activity.

Recommendation: The State Hazard Mitigation Officer should coordinate with USGS, UGMS, county geologists and other city and county officials to keep local policymakers informed on what is being learned about debris flow potential for the many canyons. In so doing, the local governments can better plan for debris flows.

Time Frame: Ongoing

Lead Agency:
CEM

Activity:

Short Term: The State Hazard Mitigation Officer should contact USGS and UGMS to see what information is available on debris flow potential. Contact county emergency directors to see what information they have and help them to upgrade their library. Make county commissioners aware of the existence of the library. Have the UGMS write a letter to each county that is prone to have debris flows informing them of their additional debris flow potential.

Long Term: Local officials will become familiar with area canyons and debris flow potential and maintain a interest in mitigating debris flows through building debris basins and funding the maintenance of these basins.

Cost: None

Warning Systems:

Background: Although a few landslide warning systems have been installed, much still remains to be done. A general lack of knowledge on warning systems could be overcome by a concerted public education effort. A conference held at CEM in 1984 presented information on various kinds of systems. As a follow-uo to that conference, perhaps other pathways could be followed to continue some momentum. There are numerous hazardous settings in Utah where warning systems are needed. These include high-hazard dams and other landslides.

Recommendation: A selected committee from the city and/or county should meet with the State Engineer, the National Weather Service and the Bureau of Reclamation to determine what type of warning system could be established for a potential dam failure. Continue to plan for warning systems in landslides, especially ones associated with possible debris flows.

Time Frame: Ongoing

Lead Agency:

State Engineer
City and County officials

Activity:

Short Term: Conduct a second conference on warning systems where specific examples of needs and suited warning systems can be discussed.

Long Term: Follow up on results from conference, working with groups that need to find funding warning systems. Work especially to get warning systems installed in dams threatening people.

Flood Control Projects:

Background: In some cases, floodplains in Utah contain critical emergency facilities, such as hospitals, police stations, sheriffs offices, fire stations, ambulance stations, etc. Because it is unlikely that these facilities will be moved, they should be protected by appropriate flood control measures.

Recommendation: An inventory of critical emergency facilities located in floodplains should be maintained. Flood control projects should be implemented to protect these facilities. Planning and construction should be carried out at the local government level, but the state should share in the expense and/or manpower depending upon who owns the facilities.

Time Frame: Ongoing

Lead Agency:

City and County EOCs CEM

Activity:

Short Term: The State CEM should take initial steps to contact city and county EOC Directors to discuss procedures. CEM should work jointly with local goverrunent flood control personnel in making the inventory and evaluating local/state responsibilities. Once responsibility has been established, local and state engineering offices can be contacted about proceeding to obtain government approval.

Long Term: The State CEM should proceed in evaluating the state's floodplains, until all situations of critical facilities in floodplains have been evaluated and adequate flood control measures have been implemented. At the same time, CEM should work with the State Office of Facilities Construction and Management in restricting the development of state buildings in floodplains, and encourage local governments to do the same.
Cost:

Expense will depend upon nature of the construction. Cost of studies for all counties: $50,000.

Ground Water Mitigation:

Background: Some communities, even counties, are dependent on mountain springs for culinary water, but watershed developers are threatening the purity of the water. Looking to the future, Utah will likely develop considerably in mountain areas with pollution into mountain drainages increasing. Such pollution will begin to have greater effects on people living at lower altitudes.

Recommendation: Increase and strengthen laws, ordinances, and regulations prohibiting and controlling development on watersheds.

Time Frame: Two years

Lead Agency:
CEM
City and County water pollution control agencies **Activity:**

Short Term: State Hazard Mitigation Officer will contact water pollution control agencies in each county to determine what laws, regulations, and ordinances exist in each county regulating the development of watersheds. Inbalances in restrictions among the counties will be evaluated. Counties that have been most successful in protecting watersheds will be studied to see what means they have used. Their approaches will be used as models. Other counties will be urged to follow

suit. County commissions will be urged to implement ordinances designed to protect their water sources. Communication pathways to state and federal agencies that allow development on watersheds will be established. Attempts will be made to establish cooperative agreements with them to protect watersheds.

Long Term: Positive approaches to protecting downstream population centers will be sought across the state, especially where culinary water pollution is involved. Laws, regulations, and ordinances will be put into place to protect culinary water springs from future pollution.

Cost:
None

Fire Hazards:

Background: In mountain areas the saturated, heavier snow loads, and winds combine to knock down more timber than usual. Downed timber litters the forest floor and helps spread fires faster. Wet years also cause heavier ground cover which later dries creating a heavier than usual dry ground cover. During the summer, these areas become fire hazards with a higher than normal potential for spreading fires. The heavier vegetation and downed timbers cross fire breaks, enhancing the chance of fires spreading. These areas constitute heavy fuel areas.

Recommendation: Downed timber from heavy snows can be sold by the state and federal forest services to commercial and individual firewood users. Construct roads to harvest the wood; these can be used as fire breaks.

Time Frame: Should begin immediately

Lead Agency:
Division of State Lands and Forestry

Activity:

Short Term: The Division of State Lands and Forestry should work with the U.S. Forest Service in setting up an accelerated timber sale program for fallen timber from the last two winters. Access roads to harvest the timber need to be built.

Long Term: Procedures are available in the U.S. Forest Service and State Lands and Forestry whereby unusual amounts of fallen timber can be disposed of through sales.

Cost:
Clearing roads: Use the money earned from timber sales and a special budget item of $200,000.

Training and Education Mitigation

Background: The professional staffs in both local and state government that have the responsibility to identify and mitigate natural hazards are relatively small in comparision to the areas they cover and it is difficult to cover all of the hazardous areas of the state. Yet hazards develop, somewhat unpredictably, in a wide variety of areas.

Recommendation: Establish a natural hazard identification training program for state and county personnel who normally work in the field so that they can function as hazard spotters at a somewhat technical level. This training could be conducted as seminars or by video tapes prepared and distributed for this purpose. Provide Police Officers' Standard Training (POST) time for participants. Such training could be provided to news media helicopter pilots who are often in the air and typically become concerned with natural hazards. Other CEM training programs could get POST approval, such as earthquake impact training.

Time Frame: Ongoing

Lead Agency:
USMS and CEM

Activity:

Short Term: Assemble a collection of 35mm slide presentations and video tape presentations aimed at instructing state and local government field personnel (of all kinds) in hazards identification and reporting procedures. Arrange seminars for these persons. As the Hazard Mitigation Handbook develops, instructional courses can be taught using the handbook as a text. Arrangements should be made with fish and game, highway patrol, parks and recreation, and other field groups for these seminars.

Long Term: Hazards training, identification, mitigation measures, and reporting techniques should somehow be reflected in the job descriptions of many state and local government field personnel. As a routine procedure, they would attend seminars to receive training in this aspect of their job. While carrying out their normal job-related duties, they can always watch for evidence of natural hazards.

Cost:

Initial budget of $10,000 to prepare visual training aids.

Background: Most every county in Utah faces some kind of array of natrual hazards. However, the people living in those counties are often not aware of the nature nor details of these hazards. It is difficult to reach so many people through conventional means of having seminars and meetings. To reach so many

people for an education program it is important to develop the means to use mass media.

Recommendation: Develop video tapes on Utah's natural hazards and provide these tapes to television stations for broadcast to viewers living in areas where these hazards exist. Each tape can cover hazards existing within a particular area, and the broadcast can be directed to those people.

Time Frame: Ongoing

Lead Agency:

Utah CEM/UGMS
Geologists' Offices, where established

Activity:

Short Term: A planning meeting should be held with Utah CEM, UGMS, and County Geologists to discuss the kinds of visual materials that should be developed for television. Preparation of these materials and expenses can also be discussed. Video film topics should be selected and details of what the films should show should also be decided on. Films could possibly be prepared in-house, or they could be contracted. A deadline should be set for completing the first film and showing it to a television station first.

Long Term: Several films should be prepared for the various areas of Utah, and these films should be shown on television frequently. These films could be stored at Utah CEM, UGMS, and at the County Geologists' offices where civic groups could borrow them. Television station managers should be worked with so that they understand the importance of educating their viewers on the presence of natural hazards in their area, on the potential impact of natural disasters and on how to prepare for natural disasters.

Cost:

A $20,000 budget should be set aside for the development of the first two or three films. This money should come jointly from local governments, UGMS, Utah CEM and through the County Geologists' Offices.

Background: The public is often not aware of who to contact or call in their area about information on natural hazards in their area. Utilizing public service announcements over the radio w"ould give this information to the public on a regular basis.

Recommendation: Provide radio "public service announcements" to advise the public on whom

to call or contact should they desire natural hazards information.

Lead Agency:

Utah CEM

Activity:

Short Term: The State Hazard Mitigation Officer should contact radio stations for policies and procedures on public service announcements. These messages can be 10 or 30-second spots and may be relatively simple to prepare. These messages should become a common feature on major radio stations.

Long Term: The public service message program should be updated from year to year, and seasonal messages should also be used regarding flood potential, etc.

Cost:

Approximately $500

Background: In the past several years numerous studies, maps, and publications have been done on natural hazards in the various counties of Utah. There has been no central storage place for all this material where the public could examine it. The logical storage place for these materials is in city and county offices where it is the most accessible. Under the NEHRP, county geologists could serve as contacts for information on natural lizards.

Recommendation: Establish Natural Hazard Information Centers in each county office. Thesc information centers would contain information on natural hazards within the county; e.g., hazard studies and hazard maps. The county geologist could also act as an information source.

Time Frame: Ongoing

Lead Agency:

County Geologists' Offices UGMS/CEM

Activity:

Short Term: Have a meeting of county geologists (where existing) at UGMS to discuss the need for the Natural Hazards Library and a time frame for assembling these libraries. The county

geologists should spend part of their work time assembling these libraries and informing the public of their presence.

Long Term: The county geologists should have a small reading room for persons using the library. The county government should consider the Natural Hazards Library as a valuable local resource in planning and development.

Cost:

A budget should be set aside by the counties each year for developing the Natural Hazards Library. Perhaps a grant could be obtained from the USGS and the UGMS to develop these libraries.

$20,000 first year $5,000 each year following

Background: Home buyers are seldom prepared to use natural hazards information when selecting a home. There are numerous examples where this caused the home buyer to make a serious mistake in selecting a home site. This has happened often enough that corrective measures need to be taken. The establishment of Natural Hazards Libraries in city and county offices will be of help. In addition, educational programs need to be arranged through continuing education programs at universities and colleges. Similar programs should be taught to high school seniors. Community sponsored courses could be taught in city community centers, much as financial planning, and other courses are.

Recommendation: Train future home owners (high school and college students) about natural hazards in areas of the state where they are most likely to reside.

Time Frame: Ongoing

Lead Agency:

County Geologists' Offices
County Engineers
UGMS/CEM

Activity;

Short Term: Conduct a State Hazards Education Workshop involving groups currently involved in providing such education. Some County EOC Directors are currently teaching seminars to schools and other groups; the Utah Museum of Natural History is doing the same; perhaps other groups are doing similar training. These groups should be brought together to plan a strategy for upgrading such teaching through a cooperative approach. The best of ideas in such teaching could be assimilated through this workshop. Further workshops could be planned. The cooperative

approach to teaching should be tested out during this coming school year.

Long Term: Create a Utah Natural Hazards Educational Committee composed of persons with such teaching responsibilities and state education policy makers. Have natural hazards education implemented into to the state's educational program for high school students. Encourage colleges and universities to include such training in basic requirement courses, such as Introductory Geology.

Cost:

No cost.

Background: Local government Emergency Management Directors have little in the way of current audio-visual presentation materials to show to civic and government groups. These materials should be accompanied with a script or sound track. Utah CEM and other agencies that deal with disasters have accumulated numerous 35mm slides and, in some cases, video tape presentations. These materials should be sorted through to see what kinds of presentations might be produced from them.

Recommendation: Develop up-to-date audio-visual presentations of aspects of hazard mitigation for state and local EOC staffs to show to interested groups as an educational medium.

Time Frame: Ongoing

Lead Agency:

CEM

Activity:

Short Term: Have state and local EOC personnel sort through their personal collections of 35mm slides and video tapes, selecting their best illustrations of hazard mitigation. Have a meeting involving these people to discuss the kinds of audio-visual materials that they have in these selected collections. Discuss the kinds of presentations that might be produced from these materials, and decide on specific presentations that should be made from these materials. Decide on how to make the presentations and on a time frame.

Long Term: Each year, conduct an audio-visual presentation planning meeting to decide on educational programs to be developed. Set time frames and means and continue to develop a library of hazard mitigation presentations to be used for educational programs across the state.

Cost: The expense should be divided between the local governments wishing to participate and with the state. Anticipated initial expense $5000.

Background: Video documentation of the damage from the last two years disasters has not been done in a systematic way. Some news channels and government agencies have made vidio tapes on parts of the disasters, perhaps relating to some part of the disaster or some agency's involvement. However, no comprehensive video tape documentation has been produced. If not just for historical value, such a video should be produced. Such a video would also be useful for a future time when disasters of similar magnitude occur. Legislative funding might be enhanced if the effects of past disasters could be shown to decision makers.

Recommendation: Produce a video tape of the damage from the past two years disasters.

Time Frame: One year.

Lead Agency:

CEM

Activity:

Short Term: The State HMO will attempt to locate all video tapes produced by federal, state, and local government agencies and television stations on the past two years disasters, and previous. Permission will be obtained to use segments of these tapes in the comprehensive tape being created. In exchange, each agency or company contributing will obtain a free copy of the comprehensive tape. A narrative will be developed for the comprehensive tape. Likely the expertise to produce this tape will exist within the agencies and companies participating, and perhaps no expense will be involved.

Long Term: Update this comprehensive tape with each year's major disasters. Likely, several tapes will result, and these can be kept in the libraries of the various agencies and companies as a reference item.

Cost:

None, unless produced professionally.

Background: After a disaster has ended, there is a tendency to relax until the next one. This is an excellent time to conduct "Lessons Learned" work shops and to document what was learned during the disaster season and apply it in the future.

Recommendation: Between periods of disasters, hold periodic hazard mitigation meetings for all interested parties to continue gathering hazard mitigation ideas for the state and to report on the implementation process of previous recommendations. These meetings should consider past events

so that we do not lose sight of our susceptibility to such disasters and the need to continue future planning.

Time Frame: Ongoing.

Lead Agency: CEM

Activity:

Short Term: After two years of Presidentially Declared Disasters, a "Lessons Learned Conference" should be held with invited speakers from the main mitigation and recovery agencies, both state and local. The conference should be of professional quality and, perhaps, held at a local hotel. The theme would be "lessons learned" and the information from the talks should be assimilated into a publication. Recommendations that result from the conference should be included in a 406 plan update.

Long Term: Following the experiences of each year's disasters, a "Lessons Learned Conference" should be held to assimilate the information and recommendations.

Cost:

Conference expenses: $10,000.

Background: Reaching the general public regarding local hazards and disaster preparedness can be difficult. A successful method used by Davis County is to place a several-page discussion on such things in the local telephone directory.

Recommendation: Local governments should publish information on natural hazards and hazard mitigation in their local telephone directory.

Time Frame: Two years.

Lead Agency:

Local Emergency Management Directors
CEM

Activity:

Short Term: A meeting will be organized by the Hazard Mitigation Officer involving the local

Emergency Management Directors to discuss the kinds of disasterrelated information that should be included in a telephone directory. The directors will contact their local telephone company offices to obtain a cost estimate. Local governments should fund their own entries in the telephone directories.

Long Term: Other types of publications that reach the general public should be studied for the possibility of including such materials in them. It is likely that over the years we will find several types of publications that can be used to reach the general public.

Cost:

Davis County's expense was about $16,000.

Organization:

Background: When the flooding of a city or town is anticipated it may be decided to direct excess water through diversion canals flooding adjacent farmlands. The cost of damage would be less to farmlands than to cities. Agreements between the cities and farmers involved should be arranged whereby flood easements in these farmlands along diversion canals are purchased by the cities. When farmlands are flooded intentionally to protect the city, the farmers financial losses are covered through the cost of the flood easements.

Recommendation: City governments and farmers should enter into agreements for the purchasing of flood easements along diversion and irrigation canals.

Time Frame: Ongoing

Lead Agency:

UDA

Activity:

Short Term: The UDA Disaster Coordinator should work with the Division of Water Resources to determine the policies on flooding farmlands versus flooding cities. Examples of such repetitive flooding should be considered for the flood easement program. High priority situations (repetitive flooding) should be investigated first and contact should be made between UDA, county agriculture officials, and city officials to determine how to establish flood easements. Agreements can be put into place between the agricultural and city interests.

Long Term: Continue to establish flood easement agreements in all situations of selective repetitive flooding.

Cost:

Surveying of flood easement lines. Cost could be substantial.

Background: Facilities Construction and Management frequently asks the UGMS for building site inspections for planned state buildings. The workload is such that a full-time engineering geologist could be employed by the state for this purpose. This geologist could have an office at either Facilities Construction and Management or at UGMS.

Recommendation: An engineering geologist should be assigned to the State Division of Facilities Construction and Management for the purpose of building site inspections for state buildings and other state financed buildings. A budget figure of about $50,000 will need to be allotted to Facilities Construction and Management or to the UGMS for this geologist.

Time Frame: One year.

Lead Agency: UGMS and Facilities Construction and Management jointly.

Activity:

Short Term: UGMS/Facilities Construction and Management will request a budget increase for the salary of the Building Site Geologist. Advertising should commence for an engineering geologist.

Long Term: State will require geologic building site inspections for all new state construction. An engineering geologist with the responsibility of inspecting all state building sites will be a permanent addition to the State organization.

Cost:

$50,000 per year.

Studies:

Disaster Documentation:

Background: The extreme variations in Utah weather and climate have been witnessed over the past 135

years. Disasters have been caused by extreme dry and wet cycles. Scientists have documented these extremes from numerous directions, but it appears that no comprehensive assimilation of these data have resulted for the documented extremes. If such a compendium existed, the details of Utah's extreme climate variations could serve as a reference handbook in evaluating each year's weather features. For comparative purposes, this compendium would be valuable to the government agencies that work with natural hazards and disasters.

Recommendation: Because the state is becoming acquainted with the extremes of climate-related disasters (drought to wet cycles), studies should be conducted to document in some detail the characteristics of the disasters that have resulted from these extremes. Summaries of these studies should be furnished to state legislators for documentation of the characteristics of these extremes; this will better enable legislators to make decisions related to Utah's climate and related disasters.

Time Frame: Two years.

Lead Agency:

State Climatologist

Activity:

Short Term: The State Climatologist's Office should seek funds to contract with a selected consultant for a study on the details of the extremes of Utah's climate and weather. This study should last not more than two years and be published by the state. A meeting should be organized between the following groups to determine what this study should include: State Climatologist, National Weather Service, CEM, UGMS, Water Resources, Lands and Forestry, and others.

Long Term: This study should be updated with each newly recorded extreme in Utah's climate.

Cost:

$20,000

Background: Although specific examples of critical emergency facilities sited in hazardous areas are known, an inventory of such occurrences has not been done statewide. Such an inventory would help assess the magnitude of the problem in responding to a disaster, such as a major earthquake. This inventory would help the local governments become aware of the need to avoid construction of critical facilities, and other facilities, in hazardous areas.

Recommendation: Prepare a study on the locations of existing critical emergency facilities, including hospitals, fire stations, ambulance services, police departments, etc., located in hazardous

areas.

Time Frame: Two years.

Lead Agency:

Local Government EOCS, coordinated through CEM.

Activity:

Short Term: A letter should be sent to local EOC Directors requesting them to provide a list of emergency facilities located in hazardous areas. Known situations should be passed onto the EOC directors in the letter. Details of the kinds of facilities and the kinds of hazard associated with that facility should be indicated. Maps should be provided to CEM on these occurrences. The information obtained from the local EOC Directors should be synthesized into a county-by-county report that can be distributed and used as needed. Preventive hazard mitigation will be considered for each facility.

Long Term: A systematic effort should be made to reduce the numbers of critical emergency facilities located in hazardous areas. Those of high priority, as indicated by the study, will be considered first. For example, a hospital located in a flood plain would be a high priority.

Cost:

Initial inventory: no cost

Background: Over the years, the lack of understanding of natural hazards in the state has made possible the construction of federal, state, and local government buildings in hazardous areas. In recent years, numerous studies have been done to report and map these natural hazards. It is possible now to show the spatial relationship of these hazards and the locations of government buildings. An inventory of government buildings located in hazardous areas would allow for a systematic program to begin the process of minimizing such occurrences.

Recommendation: Conduct a study on the locations of State and local buildings located in floodplains.

Time Frame: Two years

Lead Agency:
Local governments coordinated by CEM.

Activity:

Short Term: This study should parallel the one described above for critical emergency facilities located in hazardous areas, the activities should be the same.

Long Term: Same as for critical emergency facilities in hazardous areas described in the previous recommendation.

Cost:

None for the inventory

Mitigation Legislation:

Local Ordinances for Disclosure of Natural Hazards:

Background: Examples of litigation in the United States suggest that home buyers need to be informed of the presence of natural hazards. Local governments have the capability to inform the public of studies and locations of natural hazards. Both the state and local governments have the responsibility to consider the well being of citizens, and the concept of "buyer beware" and "acts of god" are finding less legal acceptability. To protect local and state governments from liability, efforts need to be taken to implement disclosure laws and ordinances. Some counties and cities are considering doing this. With the hiring of county geologists, currently in progress, local capabilities of disclosure will increase. The UGMS and CEM is capable of carrying out responsible disclosure tasks. Typically these tasks would involve making the public aware of studies that have been done, and then letting home buyers decide for themselves. Many home buyers are now realizing the financial drawbacks of not having been informed.

Recommendation: Work with cities and counties in designing and implementing natural hazard disclosure ordinances.

Time Frame: Ongoing

Lead Agency:

Local Governments in coordination with UGMS and CEM.

Activity:

Short Term: County Geologists (where existing) should work with their commissioners and city officials in setting up a natural hazards library for the public. Ordinances should be set into place requiring that home buyers be informed of studies on natural hazards that may, involve property that they are interested in purchasing. These studies will be kept in the natural hazards library in the County Geologist's Office. For each home purchase, a statement of natural hazards should be seen and signed by the potential purchaser of the property.

Long Term: Have each county develop their natural hazards disclosure ordinance, making the county geologist a key figure in making the public aware of studies available on local natural hazards.

Cost:

None

State Immunity From Legal Actions Resulting From Effects of Natural Disasters on People:

Background: Each year several examples of litigation against government agencies take place in the United States. The Federal Emergency Management Agency monitors this litigation and is becoming convinced that government immunity from litigation resulting from damage and injury caused by natural hazards may be eroding. Conferences on this liability issue are being held fair-Iy frequently to keep government workers abreast of the developments. The state and local governments need to be kept informed on this rapidly evolving issue.

Recommendation: To assure that state and local government officials involved in hazard mitigation remain aware of pertinent litigation and legal philosophies on immunity from natural hazard litigation, Utah CEM should maintain communications with authorities monitoring such events and situations and relay important information on to appropriate agencies within the state.

Time Frame: Ongoing

Lead Agency:

CEM

Activity:

Short Term: The Hazard Mitigation Officer should mainntain contact with the offices of legal authorities on natural hazard litigation. Information obtained from direct consultation or from conferences should be passed on to appropriate persons in the State Attorney General's Office and other interested parties. The Attorney General's Office should remain abreast of the events and provide authoritative analyses of the state of legalities regarding natural hazard liabilities.

Long Term: The state of Utah should take an active lead in developing laws that reflect the issue of liability and natural hazards. Sound legal judgments, based on events in other parts of the country, should be geared at protecting the people of the state of Utah from undue hardship caused by natural hazards.

Cost:

$2000 per year for CEM Hazard Mitigation Officer to attend and participate in conferences on legal issues related to natural hazards.

Background: If the concept of state immunity from litigation as it relates to natural hazards is being challenged in other states, a state study should be done to evaluate the legal realities of state immunity from such suits. Much information is available on legal activities relative to natural hazards in the United States. An evaluation of this information should form the basis for the state's study. As a matter of course, the study should include the realities of state's liability incurred from disclosure. At some point, as the legal philosophy of state's liability continues to change, it might be that disclosure is to the state's best interest for immunity.

Recommendation: A study should be done on the realities of the state's liability as a result of natural hazard disclosure to potential home buyers. HUD/FHA already requires developers to have studies done on natural hazards prior to approving development, and they appear to have undue liability for doing this.

Time Frame: Two years

Lead Agency:

Attorney General's Office

Activity:

Short Term: The Attorney General's Office should establish an opinion of state's liability and immunity as it relates to natural hazards, based on the manner that this issue is evolving in other states.

Long Term: Because the liability/immunity issue relating to natural hazards appears to be a dynamic one, the Attorney General's Office should monitor related events in other states on an ongoing basis. Each year the AG's office should provide an update on their initial legal opinion.

Cost:

None

Funding:

Establishment of a Permanent Disaster Relief Fund:

Background: The prevention of disasters resulting from natural hazards could save Utah millions of dollars; preventive hazard mitigation is cost effective. A main problem in pursuing preventive measures is the lack of funding. While it is difficult to see the savings derived from applying preventive measures, still it is logical that such measures could only prevent damage to property and protect people. Prevention is a healthy concept and it needs to be given much thought. It is analogous to defensive driving, preventive health care, and fire prevention - much money is spent annually on these concepts.

Funds from this revolving fund could also be used for ongoing recovery from disasters. The concept of a revolving disaster relief fund was widely recommended through state and local government.

Recommendation: A permanent state disaster relief fund should be established that will also fund mitigation activities at various levels of government. Preventive measures could be funded on a priority basis; mitigation of disaster damage could also be funded. State purchased bonds might be a way of obtaining the moneys. Moneys could be loaned at low interest. Repayment would keep the fund viable and increasing. Funding would be based on a prioritizing procedure.

Time Frame: Ongoing

Lead Agency:

State Disaster Relief Board
CEM

Activity:

Short Term: The legislature should be approached on the positive aspects of a self-perpetuating, interest-bearing, permanent disaster relief fund and requested to establish such a fund as part of the state DRB. Adequate seed Morley should be supplied to initiate the fund. Part of the interest earned by the fund can be used for preventive measures that are not repaid. It would help if the state division heads voiced their support as part of the lobbying process.

Long Term: As the fund becomes larger over the years, the state will be able to mitigate hazards at a more rapid rate.

Cost:

Funded to estimated annual need.

Establish A Method For Prioritizing Hazard Mitigation Needs For Funding:

Background: When the hazard mitigation funds described are created, then decisions must be made as to how to use those funds. Because Utah has too many hazards to mitigate at any one time, a numerical prioritizing procedure should be established, perhaps the Integrated Emergency Management System. Those hazards threatening life would receive the highest numerical score, with other criteria following. Hazards ranked as highest priority would receive funding first.

Recommendation: Establish a more effective method of prioritizing hazards for funding so that existing funds can be used more effectively.

Time Frame: One year

Lead Agency:

CEM with DRB

Activity:

Short Term: Meet with division heads from state and local governments who deal with hazard mitigation. Discuss possible criteria for ranking of hazards and develop a ranking procedure. Consider the IEMS method as one alternative.

Long Term: Meet annually with the division heads who helped devise the ranking system to see how it should be updated.

Cost:

None

Procedures:

Background: To facilitate communication on activities in the various state and local government agencies, the agency disaster coordinator or county Emergency Management Director should maintain a written and photographic journal documenting natural hazard-related activities under his/her jurisdiction. Without this action, much information goes unrecorded that can be useful later when writing reports or developing plans. This is certainly the case in preparing a state hazard mitigation plan such as this one. These journals should

contain information on dates and activities and expenses incurred by the agency in dealing with natural hazards. Photographs, preferably black and white prints, should be kept in the journal with negatives filed and retrievable.

Recommendation: Request that emergency/disaster coordinators in the various government agencies prepare and maintain a journal that documents a chronology of disaster/emergency involvement. Also, request that they prepare and maintain a file of photographs documenting disasters/emergencies within their area of involvement.

Time Frame: Ongoing

Lead Agency:

CEM

Activity:

Short Term: The CEM Director will write a letter directed to all other agency directors and local government EOC Directors requesting that adequate journals be maintained.

Long Term: Use the hazards activities journals as a resource when data from particular time periods are needed.

Cost:

Negligible

Background: The design of hazard mitigation preventive measures, especially where repetitive damage has occurred, can be facilitated through viewing video tapes of the disaster as it occurred. The nature of previous flooding at a particular site can be studied through video, as can any particular problem hazard being considered for preventive measures.

Recommendation: Air and ground video tape documentation of disasters will play a key role in hazard mitigation planning. Tapes should be made demonstrating the intensity of the natural process involved and the impact of the disaster. Tapes should be made of the resulting mitigation activities.

Time Frame: Begin immediately

Lead Agency:

Each agency (local or state) involved with mitigation should obtain and use a video camera for this

purpose.

Activity:

Short Term: Each agency (local and state) involved with mitigation should obtain a video camera. Instructions on the use of a video camera in the field will be provided by Utah CEM. Each agency should have their disaster coordinator document disasters as they occur, and they should begin now by documenting old damage and examples of mitigation. A library of video tapes should be kept on file by each agency. The county geologists should use video cameras to document hazards in his/her county, and this can become part of the County Natural Hazards Library.

Long Term: A library of such tapes should be preserved. Copies of tapes should be stored separately from the originals.

Cost:

About $2000 per state and county agency involved.

Background: Today's technology makes it possible for the state (or local) EOCs and the Governor's Office to see live closed circuit television viewing of disaster scenes. During a major disaster, such viewing could be critical to the decision-making process in responding to the disaster. Central viewing at critical emergency services facilities, such as fire stations and sheriffs' offices could make their decision making easier also, especially if television coverage were done from the air.

Recommendation: Consideration should be given to obtaining video transmission capability from disaster scenes to the Governor's Office, Utah CEM, UDOT Headquarters, and other agencies working with hazards. Visual observation plays a key role in making decisions during disasters. Copies of such video tapes can be used in the hazard mitigation planning process, both as regarding structural and nonstructural approaches to mitigation.

Time Frame: Three years

Lead Agency:

CEM

Activity:

Short Term: The Hazard Mitigation Officer should study the feasibility of live coverage of disaster scenes through visits with local television stations. Equipment and manpower costs and training will be considered. A workshop will be conducted involving state and local government division heads and a representative from the Governor's Office to discuss the pros and cons of this capability. If

a concensus arises in favor of the system, the Department of flublic Safety could pursue obtaining the equipment and training.

Long Term: Use the System as needed. Have training exercises for operating the system.

Cost: To be investigated

Coordination Between Local Government And Private Sector:

Background: Disasters can seriously affect our way of life by damaging lifelines such as, natural gas, electrical supply, culinary water, sewage treatment, and telephone communication. It is essential that utilities be included in state and local hazard mitigation and disaster preparedness planning. The state and local governments need to understand the plans developed by utilities, and they about governments.

Recommendation: State and local government agencies should coordinate with private utility companies regarding their hazard mitigation and emergency preparedness plans.

Time Frame: Ongoing

Lead Agency:

Local Emergency Management Directors CEM

Activity:

Short Term: Local Emergency Management Directors need to be made aware of this recommendation and be encouraged to plan meetings with utility company personnel to compare plans.

Long Term: Establish a working relationship with private utility companies in hazard mitigation and emergency planning.

Cost: None

GEOLOGIC-HAZARDS RECOMMENDATIONS UTAH GEOLOGICAL SURVEY

The following hazard mitigation recommendations were submitted by the Utah Geological Survey through the UGS Interagency Technical Team member for inclusion in the Utah Hazard Mitigation Plan - 1999. The lead agency for implementation is the Utah Geological Survey.

RECOMMENDATION 1

Reduce geologic-hazards losses by mapping and identifying geologic hazards. Prepare large-scale hazards maps (1:24,000-scale or larger) for urbanizing areas to identify potential hazard areas.

RECOMMENDATION 2

Make land-use compatible, through local government ordinances, with known hazards. Local government should adopt and strictly enforce geologic-hazards ordinances requiring site-specific hazards studies prior to development. Hazards studies should be reviewed by qualified professionals acting on behalf of the local government, and ordinances should include a means to ensure that hazard-related recommendations are followed.

RECOMMENDATION 3

Perform geologic-hazards investigations for critical public facilities. Public facilities, particularly those that are critical for public safety, should not be subject to geologic hazards and should remain in service following a natural disaster.

RECOMMENDATION 4

Develop a statewide, real-time earthquake monitoring system. The state's present earthquake-information system needs to be modernized to provide real-time (within minutes of an earthquake) maps showing where the worst damage is likely so that emergency responders know instantly where they are most needed. An added benefit of the modernization is to provide information vital to engineers and scientists to design better buildings.

RECOMMENDATION 5

Improve and expand other existing earthquake instrumentation programs, including the strong-motion and Global Positioning System (GPS) programs. Both the strong-motion and GPS programs are vital to understanding the earthquake hazard in Utah, and must be expanded to include more permanent stations and moderized with new technology.

RECOMMENDATION 6

Update estimates of direct and indirect losses associated with earthquakes of various magnitudes and locations using FEMA=s new HAZUS loss-estimation models.

RECOMMENDATION 7

Expand programs to evaluate landslide hazards. The landslides of 1997-8 have shown that Utah is vulnerable to landslides, including debris flows. More research is needed to understand the causes of landslides and nature of landslide hazards.

RECOMMENDATION 8

Increase public awareness of geologic hazards. Inform citizens about geologic hazards, incorporate geologic-hazards education into school curricula, and keep professionals, government officials, and educators up-to-date on pertinent information.

RECOMMENDATION 9

Disclose geologic hazards in real-estate transactions. Buyers need accurate information to make informed decisions when purchasing a home.

ADDITIONAL GEOLOGIC HAZARD RECOMMENDATIONS

The following hazard mitigation recommendations were included in the original State Hazard Mitigation Plan - 1983. They are included here, primarily for reference. Many of these are ongoing tasks, or still require some degree of implementation.

On August 11-12, 1983, a Governor's Conference on Geologic Hazards was sponsored by the Utah Geological and Mineral Survey in Salt Lake City. As part of this conference, experts in the area of geologic hazards and how geology relates to society outlined 171 action items that the state needed to address.

The following implementation measures were generated by the working groups at the conference. Thirty-two are short term measures and eighteen will require long term implementation. Of the 171 action

items recommended by the 36 working groups, these fifty measures will receive first priority. The other items remain under assessment and study for future implementation.

These recommendations are retained as part of the present State Hazard Mitigation Plan - 1999.

Landslide Safety

Problem: In the most damaging failures of 1983 were classic debris flows. We have learned a great deal about these failures in the past twenty years but many of the critical studies leading to reduction of damages have not been completed.

Implementation Measure:

Several studies are proposed which apply to this. They are: model studies of flow processes; characteriztion of susceptible source areas, materials, and deposits; effects of microstructure on the distribution of soil slips/debris flows; comprehensive instrumentation of a selected watershed to measure pore water pressures, precipitation, runoff, and deformations; and research to establish recurrence intervals for such events.

Lead Agency And Time:

Utah Geological and Mineral Survey (UGMS)
Universities
Five Years

Status: Ongoing

Problem:

During the disaster of 1983, much of the concern and damage was associated with failure of reservoirs. One reservoir failed, two others (Gunnison and Huntington) caused great concern, one (Twin Lake in Twelve-mile Canyon) was partially drained to prevent a potential disaster, and several others, including Joe's Valley and two reservoirs in American Fork, were involved in landsliding.

Implementation Measure:

A reconnaissance investigation of reservoirs should be completed to identify those with potential problems from landslides and other defects. An evaluation of hazards should be made and owners of reservoirs that could fail during a continuation of the present weather cycle should be notified.

Lead Agency And Time:

Division of Water Rights One Year

Status: Ongoing

Problem:

The landslide at Thistle demonstrated how vulnerable our commerce is to disruption by landslides. The landslide at Thistle was a reactivation of a large, old landslide that has moved small amounts through much of this century. The reactivation of large, old landslides is related to rising subsurface water levels in response to abnormally high precipitation. A continuation of even normal precipitation will undoubtedly trigger more landslides of the same type.

Implementation Measure:

In conjunction with land use planners, identify areas which are critical for maintenance of essential transport of energy and commodities. Conduct a reconnaissance of these areas to identify areas of past landsliding and visit particularly critical sites to evaluate the likelihood of reactivation of landslide movements.

Agency And Time:

UGMS
Department of Transportation (DOT) Two Years

Status: Ongoing

Problem:

One of the overlooked, but important hazards in the metropolitan areas along the Wasatch Front is the failure of the "benches." These small failures are probably caused by high ground water levels and imprudent construction practices and result in large damage to property.

Implementation Measure:

A basic study of past failures is needed to determine habitat, materials, influence of construction and drainage changes, and intensity of events. From this, an evaluation of where problems are most likely to occur may lead to public acceptance of grading codes and avoidance zoning as

mitigation methods.

Lead Agency And Time:

UGMS
One Year

Status: Ongoing

Problem:

Inadequate assessment of debris flow hazards along the Wasatch Front south of Salt Lake City.

Implementation Measure:

Use techniques similar to those in USGS Open File Report No. 83-635 for canyons in Utah and Sanpete Counties to map hazards for 1984 water year; continue evaluation of high hazard areas identified by USGS in 1983; and investigate historical conditions of debris flow incidence in these areas.

Lead Agency And Time:

UGMS
U.S. Geological Survey (USGS)
Five Years

Status: Ongoing

Dam Safety

Problem:

Annual operation and maintenance costs for dam owners. Many owner-operators neglect performing preventive maintenance.

Implementation Measure:

Inform public of ownership of structures. Establish statewide quality criteria. Require annual operation and maintenance budget. Require owner to purchase maintenance bond.

Lead Agency And Time:

Division of Water Rights One Year Status:

The public has not been informed of the ownership of structures; however statewide quality criteria do exist for high-hazard dams over 50 acre feet. There is some question as to whether the state has statutory authority to carry out much of this recommendation or to be directed to do it.

Problem:

All dams need to be inspected. State law provides that owners could pay for inspection, but the state has always done this for free.

Implementation Measure:

Start a program of owner-financed inspections.

Lead Agency And Time:

Division of Water Rights One Year

Status: Pending

This concept has been examined over the years, however, billing procedures are counter productive. Increased filing fees for water rights is one possibility for funding inspections. If a private person requests an inspection, they can be charged for the inspection. The main idea of owner-financed inspections has been disregarded.

Problem:

There is now no insurance requirement for liability incurred by the failure of privately owned dams in Utah.

Implementation Measure:

Propose legislation requiring private dam owners to obtain and maintain adequate liability insurance.

Lead Agency And Time:

Division of Water Rights One Year

Status: Likely not to happen

Hazard Mapping

Problem:

Maps identifying mud and debris flow hazards within Utah communities do not currently exist. FEMA, through the National Flood Insurance Program, has identified clear water flood hazard areas for all communities at risk in the state and is beginning an effort to map the hazards associated with mud and debris flow areas. Without this data and the federal requirement to adopt it as a part of a local flood plain management ordinance to maintain eligibility in the NFIP, few Utah communities would adopt mud and debris flow management programs independently. The NFIP is beginning a limited mud and debris now mapping program. However, it could be several years before a detailed mapping program is complete for the entire Wasatch Front, considering the current program.

Implementation Measure:

The boundaries of mud and debris flow areas from recent events were well documented and should be adopted by local governments as the basis for mud and debris flow management programs until detailed studies of these areas can be accomplished. Local governments should adopt mud and debris flow ordinances (available from FEMA) for these areas. An added incentive would be to link state funds for recovery to the adoption of these ordinances. The limited FEMA program to add mud and debris flow hazards to flood insurance maps could be accelerated by cost sharing from state and local governments. It is also important to assure that the FEMA effort to map debris flows is continued at the current level. This can be accomplished by advising the FEMA national office and the Utah congressional delegation of its importance and backing it up with state and local funds.

Lead Agency And Time:

UGMS
USGS
Five Years

Status: Ongoing

Problem:

Accompanying all the data being generated are maps identifying different threats, hazard zones, insurance rates, drainage patterns, lake levels, etc.

Implementation Measure:

This information should be systematically compiled with consideration given to: (1) adopting a uniform scale creating digitized overlays; (2) compiling a statewide multi-hazard map; (3) encouraging processing of 1981-83 USGS Landsat photo imagery data for producing photo maps of the Wasatch Front; (4) incorporating information generated from authorized NFIP restudies that use methodologies for alluvial fan flooding rather than the more common clear back-water analysis.

Lead Agency And Time:

UGMS
USGS
FEMA
U.S. Forest Service
Five Years

Status: Ongoing

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Problem:

When sufficient data and information are available, hazard maps should be developed to identify areas according to low, moderate, or high risks, or some other appropriate basis.

Implementation Measure:

Statewide hazard maps should be developed for debris flows and debris floods. This mapping is needed before hazard zoning and disclosure laws can be effectively impi(-reented. As, more data becomes available, any such rezips would 'need to be revised and updated.

Lead Agency And Time:

UGMS
Five Years

Facility Siting and Inspection

Problem:

Many public facilities are not required to obtain a comprehensive geologic hazard review before approval for site and construction. State and local agencies, as well as private hospitals and critical care facilities, need guidance on geologic hazards.

Implementation Measure:

Require review of all state and critical care facilities by the state geologist prior to funding approval.

Lead Agency And Time:
UGMS
Division of Facilities and Construction and Management
One Year to set up; ongoing program.

Status: Ongoing

Problem:

In some instances geologic data are not being used in school site selection.

Implementation Measure:

The State Office of Education should secure the approval of the USGS before giving final approval to local school districts for construction of school facilities.

Lead Agency And Time:

State Board of Education One Year

Status: Ongoing

On a semi-formal basis, the State Office of Education has a strong commitment to ask the UGMS to provide school building site inspections for natural hazards.

Problem:

Drinking water facilities are essential to a community but they are often located in areas of geologic risk. The Bureau of Public Water Supplies is empowered to review and approve plans for all new drinking water

system projects, but evaluation of geologic hazards in not emphasized.

Implementation Measure:

As part of its normal review process for all new spring sources, wells, treatment plants, transmission lines, and finished water storage reservoirs, the Bureau of Public Water Supplies should require an engineering geologist's report to be submitted for review prior to the design of the project. The report would address the geologic hazards of the project site and make recommendations in this regard. Utah's Public Drinking Water Regulations :should be appropriately amended.

Lead Agency And Time:

Bureau of Public Water Supplies
Department of Health
One Year

Status: Pending

Problem:

Failure of many septic tank soil absorption fields, chiefly due to high ground water, during this wet year has posed serious health hazards to the people of the state. The present health code, in terms of regulations and enforcement, is inadequate as it relates to siting of septic tanks. Revisions are needed which would include more strict regulation of septic tank placement in areas of high ground water, shallow bedrock, and flood hazard. Chief among these is the need for a greater separation distance between drainfield lines and the water table.

Implementation Measure:

Adoption of revisions to Part IV of the State Health Code as proposed by the Bureau of Sanitation, requiring a minimum 4-foot separation between drain-lines and the water table.

Lead Agency And Time:

Department of Health One Year

Status: Ongoing

Problem:

Local flood plain managers need more training in NFIP, flood mitigation, and post-recovery activities.

Implementation Measure:

Train local flood plain managers in the goals and objectives of NFIP, flood mitigation, and post-flood recovery.

Lead Agency And Time:
CEM
Six Months

Status: Ongoing

Problem:

Local planning and zoning commissions do not always consider hazards.

Implementation Measure:

Hazards should be a normal part of staff reports to planning and zoning commissions. If local staff does not have expertise, UGMS should be consulted.

Lead Agency And Time:

CEM
UGMS
Two Years

Status: Ongoing

Problem:

Funding for hazards needs to be addressed. Most local governments do not possess adequate money for study, mitigation, or cleanup. They may not have adequate authority or a mechanism to implement hazards work. They require technical assistance for new work, including structures, rehabilitation, and monitoring in-place structures for hazard work.

Implementation Measure:

Recommend changes to improve the adequacy of federal and state emergency funds in amount and

authority for use. State and federal authorities should assist local entities with dam safety, new structures, and budgeting for all hazard work, including maintenance.

Lead Agency And Time:

CEM
DCED
Division of Water Rights One Year

Status:

Miscellaneous

Problem:

Lack of policy advisory group at the state level on geological hazards.

Implementation Measure:

An advisory policy group should be formed with representatives from the following groups: (1) earth scientists; (2) engineers; (3) public officials; (4) business and industry; (5) general public.

Lead Agency And Time:

CEM One Year

Status: Pending

To date nothing specific has been done.

Problem:

The statute which mandates a strategy to maintain the lake level at 4202 also mandated that the Department of Natural Resources define and manage the lake flood plain as a hazard zone. The statute did not provide a mechanism for definition and management of the flood plain.

Implementation Measure:

Send this back to the legislature for further definition and a mechanism to achieve its definition and management. It would be more efficient for the legislature to pronounce its long-range policy on

the Great Salt Lake and then ask the Department of Natural Resources to confirm its programs accordingly, rather than the state agencies constantly trying to sell their own policies to the legislature.

Lead Agency And Time:

State Legislature
One Year

Status: Ongoing

Problem:

There are no stream gauging stations in current operation in Davis County. (There were many in the 40's, 5O's and 60's.) Lack of stream gauging stations adversely affects the ability of technical expertise in assessment of geological hazards as related to predicting effects/impacts on downstream improvements caused by high stream flows, landslides, mud flows, etc.

Implementation Measure:

Reactivate selected stream gauging stations in Davis County. consider reactivation or new gauge stations where critically needed, and elsewhere where identified geologic hazards and downstream impacts dictate such investments for public safety. Implement company agreements or memoranda of understanding to get cooperative effort and commitment.

Lead Agency And Time:

USGS
U.S. Forest Service
Division of Water Rights
Two Years

Status: Pending

Problem:

Inadequate attention and resources have been devoted by the state over the years to the protection of shallow ground water resources. Virtually no standards exist for the protection of shallow ground water. In some areas shallow ground water is in direct contact with aquifers which are used for culinary purposes. In other areas shallow ground water is the only usable source for culinary purposes.

Implementation Measure:

Develop a state policy which addresses the quality and use of shallow ground water. Standards need to be developed which prevent the degradation of the quality of shallow ground water.

Lead Agency And Time:

Department of Health

Status: Completed

HAZARD MITIGATI0N RECOMMENDATIONS

QUAIL CREEK DIKE BREACH
Jan. 1, 1989
Utah 820-DR - January 31, 1989

The State Hazard Mitigation Plan for the Quail Creek Dike Breach was provided to FEMA in July 1989, following the disaster that began at about midnight, January 1, 1989. The following hazard mitigation recommendations are retained in this present plan. Other recommendations were made obsolete as time passed, or due to the well-mitigated dam (constructed of roller-compacted concrete) that has greatly lessened dam failure inundation threat along the Virgin River in Washington County. Some recommendations were not mitigation, but disaster preparedness or response.

RECOMMENDATIONS (Reference Quail Creek Dike Breach - State Hazard Mitigation Plan 1989):

The following recommendations are considered to still be viable for implementation through the present State Hazard Mitigation Plan - 1999.

Conduct an annual flood awareness week in Washington County prior to spring runoff. Create awareness of flood hazard mitigation techniques for home and business, as well as the availability of flood insurance.

Develop a high school Hazard Education Lecture Packet (HELP) through a coordinated effort of the State Office of Education, school districts, and high school science teachers.

A comprehensive Natural Hazards Reduction Planning and Awareness curriculum should be taught at a Utah university/college. The program should include an adequate array of courses to provide the proper amount of training, such that a student completing the program could begin professional work in the field of emergency management.

Form a state-lead task force to prepare legislation establishing a self-insurance pool for the reparation of downstream damage resulting from a dam failure.

The city of St. George should prepare a hazard mitigation plan addressing a comprehensive array of of major hazards that face the city.

CONCLUSION

This State Hazard Mitigation Plan, as presented here is really the core of a much larger body of Utah hazard mitigation planning materials that relate to wildfire, debris flow, and even earthquake (contained in A Strategic Plan for Earthquake Safety in Utah). Additionally, Davis County Hazard Mitigation Planning is being revised through Project Impact, and the selected community of Centerville, and this planning is being updated for all manner of natural hazards. The Davis County update will consist of a FLO-2D analysis and model, for Deuel Creek in Centerville, being developed by the U.S. Army Corps of Engineers. Centerville is developing a Flood Hazard Mitigation Plan for its western section of the city. These sections will be added shortly.

Several new recommendations are provided in this present Plan, being derived from Utah Interagency Technical Team (IAT) ONSITE reports, county vulnerability and mitigation analyses (for flood only; not including those for wildfire and earthquake), and from local government hazard mitigation plans developed as selected hazard plans for various communities in Utah.

This Plan will be updated, or added to on a regular basis, as pertinent material is developed. In its present condition, the Plan is comprehensive and Statewide.

It is requested that the State and Federal agencies of the Utah Interagency Technical Team (IAT) perform their tasks defined at the teams inception in 1988 to implement the State Hazard Mitigation Plan, as coordinated by the Utah Division of Comprehensive Management.

The Utah Division of Comprehensive Emergency Management is the State coordinating agency for emergency management. As such, Utah CEM attempts to focus the mitigation resources of the various State agencies on the implementation of these recommendations. Each State agency involved should review this plan and pursue implementation of recommendations, as seems appropriate to them within their areas of responsibility. Often funding resources are rare. Recent survey of State agencies showed that such resources are somewhat rare. The IAT representatives of State agencies are encouraged to locate

additional resources within their segment of government to be applied to hazard mitigation.

Utah CEM will continue to assist local governments in a coordinating role through the efforts of the Utah IAT in local government planning, ONSITE assistance providing technical perception of risk and mitigation, and the development of local vulnerability and mitigation assessments. Additionally, the IAT will continue to glean experience by providing ONSITE assistance.